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ABSTRACT

This document, which is the first part in a two-part set of modules on anatomy and physiology for future surgical technicians, contains the teacher and student editions of an introduction to anatomy and physiology that consists of modules on the following topics: (1) organization of the human body; (2) biochemistry and microbiology; (3) infection, immunology, and sanitation; and (4) tissue, membranes, and wound healing. The teacher edition contains an introductory section and the learning modules. The introduction presents the following materials: an overview of the materials and guidelines for their use; an instructional/task analysis identifying the cognitive skills addressed in each module; academic and workplace skill classifications and definitions of the basic skill classifications used by the Multistate Academic and Vocational Curriculum Consortium and the Secretary's Commission on Achieving Necessary Skills; and a list of related academic and workplace skills. The remainder of the teacher's edition consists of the learning modules plus the following items for each: suggested activities; transparency masters; written tests and test answers; assignment sheets and answers; crossword puzzles and answers; and module reviews and answers. The student edition consists of the four learning modules, each of which contains the following elements: learning activity sheets; module objective sheet; information sheets; student supplements; and student assignment sheets. (MN)

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Anatomy and Physiology
Teacher Edition [and] Student Edition

Module Set I: Introduction to Anatomy and Physiology

Surgical Technology

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Introduction
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Teacher Edition

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Surgical Technology

Anatomy and Physiology

Module Set I:
Introduction to Anatomy and Physiology

Teacher Edition

Project written by
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MODULES WITHIN SET

Module 1: Organization of the Human Body

Module 2: Biochemistry and Microbiology

Module 3: Infection, Immunology, and Sanitation

Module 4: Tissues, Membranes, and Wound Healing

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Use of Introductory Materials

Introductory materials are included in the teacher edition only and contain useful information to assist administrators and teachers in planning for instruction.

In addition to the general information—such as the table of contents and acknowledgments page—information is included on the following:

1. **Use of this publication**—Explains the components of a module of instruction and how they should be used as part of the teaching/learning process.
2. **Instructional/task analysis**—Provides a quick review of the contents of the publication and identifies the cognitive (knowledge) skills addressed in each module of instruction.
3. **Academic and workplace skill classifications and definitions**—Defines the basic-skill classifications used by MAVCC. Skill areas reflected by skill groups, subskills, and definitions have been identified using *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.
4. **Related academic and workplace skills list**—Classifies assignment sheets according to the related academic and workplace skills being reinforced.
5. ***Crosswalk to AST Core Curriculum Objectives**—Indicates MAVCC module objectives identified in the Association of Surgical Technologists, Inc.'s, *Core Curriculum for Surgical Technology*, 4th ed., Englewood, Colorado, copyright 1996.

As you use these materials, it is hoped that they will provide useful information to meet a variety of needs.

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*A complete crosswalk for Module Set I and Module Set II will be included in the teacher edition for *Anatomy and Physiology, Module Set II: Major Body Systems.*

Use of This Publication

Instructional modules

Anatomy and Physiology will consist of two editions: this publication, *Module Set I, Introduction to Anatomy and Physiology*, and a second publication, *Module Set II, Major Body Systems.*

Module Set I contains four modules of instruction:

Module 1: Organization of the Human Body
Module 2: Biochemistry and Microbiology
Module 3: Infection, Immunology, and Sanitation
Module 4: Tissues, Membranes, and Wound Healing

Module Set II will contain 15 modules of instruction:

Module 1: Integumentary System
Module 2: Skeletal System
Module 3: Muscular System
Module 4: Nervous System
Module 5: Endocrine System
Module 6: Special Senses
Module 7: Circulatory System—Blood
Module 8: Circulatory System—Cardiac
Module 9: Circulatory System—Vascular
Module 10: Lymphatic System
Module 11: Respiratory System
Module 12: Digestive System
Module 13: Urinary System
Module 14: Reproductive System—Male
Module 15: Reproductive System—Female

Each instructional module in a student edition includes some or all of the following components: learning activities sheet, module objective sheet, information sheet, student supplements, and assignment sheets.

Each module in this teacher edition includes some or all of the following components: suggested activities, transparency masters, teacher supplements, written test, answers to written test, answers to assignment sheets, optional assignment sheets, answers to optional assignment sheets, crossword puzzles, answers to crossword puzzles, module review, and answers to module review.

All of the module components focus on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Modules of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each module of instruction by the teacher will help to determine the following:

- Amount of materials that can be covered in each class period.
- Skills that must be demonstrated.

- Amount of class time needed for teacher demonstrations.
- Amount of time needed for student practice.
- Supplementary materials, including print and nonprint media and equipment and supplies, that must be ordered.
- Resource people who must be contracted.

Student-edition components

It is a challenge to keep students motivated. Instructors should supplement the student-edition components by providing the "why," personal experiences, and current information. Prepare for each module by deciding how each component can best be taught. Allow students to become involved in preparing and planning their teaching/learning experiences.

Learning activities sheet. The learning activities sheet supplied in each module is a step-by-step instruction sheet instructors may use to guide each student's individual study through the required components in the student edition (module objective sheet, information sheet, student supplements, and assignment sheets). The learning activities sheet also provides space for the instructor to include selected web sites and optional assignments and activities, which allow the instructor to use his or her discretion in providing students with additional objectives in the same subject area as the required objectives provided in the student edition.

Module objective sheet. Each module of instruction is based on performance objectives that state the goals for successful completion of the course. These performance objectives are presented in two forms: module objectives, which state the expected performance of each student after completion of the module of instruction, and specific objectives, which state what the student must do to reach the module objective.

The objectives should be stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional module. The objectives can also help determine teaching strategies and instructional methods. Teachers should prepare for each module by deciding how each objective can best be taught.

Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When objectives are added, the teacher should remember to supply the needed information-sheet, assignment-sheet, written-test, and module-review items.

Information sheet. The information sheet provides the content essential for meeting the cognitive (knowledge) objectives of the module. Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the module objective.

Student supplements. The information presented in a student supplement may consist of tables, charts, written information, forms, or other information students will need in order to complete one or more of the assignment sheets. Students are not directly tested over the information presented in a supplement; however, their ability to apply this information will be evaluated in the completion of an assignment sheet.

Assignment sheets. Assignment sheets provide students with pencil-and-paper activities that give students the opportunity to make practical application of the knowledge in the information sheet and student supplements. Criteria are provided to objectively evaluate student performance.

Teacher-edition components

Suggested activities. The suggested activities assist teachers during the preparation stage of the teaching/learning process by providing an instructional plan, teaching suggestions, and a list of supplemental resources. The teacher should read the suggested activities before teaching a module and decide how each objective can best be taught. Time should also be allowed to obtain supplemental materials, prepare audiovisual materials, and contact outside resources. Duties of the teacher will vary according to the particular module.

References used in the development of each module, suggested web sites for student use, and supplemental resources are listed in the suggested activities. These materials can be used by the teacher to supplement her or his knowledge of the subject area or to help students with objectives in the area covered by a module of instruction.

Transparency masters. Transparency masters provide illustrations, charts, schematics, or additional information a teacher may use in group discussion to direct the students' attention to the topic of discussion.

Written test. This component is a criterion-referenced evaluation of the cognitive objectives presented in the information sheet. If the instructor has added, deleted, or modified objectives presented in the information sheet, appropriate changes should be made on the written test. It is recommended that the test be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered and before students attempt the assignment sheets presented in the student edition. The written test is included in the teacher edition only, but duplication is permitted for student use.

Answers to written test. These answers are designed to assist the teacher in evaluating student performance on the written test.

Answers to assignment sheets. Assignment-sheet answers are designed to assist the teacher in evaluating student performance on the assignment sheets presented in the student edition.

Optional assignment sheets. When present in the teacher edition, these are optional assignments for the teacher to use to provide students with higher-level materials to stretch the advanced student or with remedial information or practice to assist the less-advanced student. These optional assignments may be duplicated for student use.

Answers to optional assignment sheets. These answers are designed to assist the teacher in evaluating student performance on the optional assignments presented in the teacher edition.

Crossword puzzles. Medical terminology and the spelling of medical terms are often difficult for students of anatomy and physiology. Crossword puzzles are presented in the teacher edition as optional resources for teachers to use to give their students practice in learning to spell and define the medical terms presented in each module of instruction. The crossword puzzles are included in the teacher edition only, but duplication is permitted for student use.

Answers to crossword puzzles. These answers are designed to assist the teacher in evaluating student performance on the crossword puzzles.

Module review. The module review is an objective test of the information presented in any of the components presented in the student edition. The objective questions are designed to test on many cognitive levels, and an attempt has been made to present some critical-thinking objective items in each module review. The module review is included in the teacher edition only, but duplication is permitted for student use.

A selection of test items from the modules covered may be used for a final test at the end of each term if desired. It is hoped that the objective format of the module reviews will help students prepare for the tests they must pass for certification in the various surgical-technology areas.

Answers to module review. These answers are designed to assist the teacher in evaluating student performance on the module review.

Instructional/Task Analysis

Module 1: Organization of the Human Body

Related information: What the student should know

1. Define the terms *anatomy* and *physiology*.
2. Define the term *anatomical position*.
3. Label the common body planes.
4. Match the directional terms used in anatomy to their correct descriptions.
5. Describe the locating terms used in anatomy.
6. Describe the body positions.
7. List the general regions of the body.
8. State the contents of the major body cavities.
9. Label the quadrants of the abdominopelvic cavity.
10. Match the major abdominopelvic organs to their correct quadrant locations.
11. Label the regions of the abdomen.
12. List the major body structures in order of increasing complexity.
13. Match the major organ systems to their correct functions.
14. List the major organs and structures in each of the major organ systems.

Application: What the student should be able to do

15. Practice critical thinking: use directional terms to describe surgical incisions. (Assignment Sheet 1)
16. Define medical terms. (Assignment Sheet 2)

Module 2: Biochemistry and Microbiology

Related information: What the student should know

1. Define the terms *biochemistry* and *microbiology*.
2. Discuss the role of chemistry in human health.
3. Define the term *homeostasis*.

Module 2: Biochemistry and Microbiology (continued)

Related information: What the student should know (continued)

4. Define the term *element.*
5. Define the term *atom.*
6. Label the parts of an atom.
7. Define the term *molecule.*
8. Distinguish among the definitions of the terms *compound, mixture,* and *solution.*
9. Describe the primary role of each of the principal elements and compounds in the body.
10. Complete statements that describe the chemical reactions that take place in the body.
11. State the functions of the major types of organic compounds in the body.
12. Complete phrases that describe the components of the major types of organic compounds in the body.
13. Complete statements that describe the major elements and compounds that compose the body.
14. Define types of solutions.
15. Define the major types of fluid in the body.
16. Define the term *electrolyte.*
17. Discuss the role of electrolytes in human health.
18. Discuss the role of acids and bases in human health.
19. Define the term *metabolism.*
20. Complete statements that describe the use of energy by the body.
21. Complete statements that describe the characteristics of body temperature.
22. State definitions of the basic activities that define life.
23. State the cell theory.
24. State the functions of the compounds found in protoplasm.
25. Define the principal types of protoplasm.
26. Label the major parts of a cell.
27. Match the major parts of a cell to their correct functions.
28. Describe the major parts of a cell nucleus.

Module 2: Biochemistry and Microbiology (continued)

Related Information: What the student should know (continued)

29. Describe the specialized structures in cells.
30. State the functions of the specialized structures in cells.
31. List the functions of a cell.
32. Define the term *transport.*
33. Distinguish between descriptions of the terms *active transport* and *passive transport.*
34. Match types of passive transport to their correct descriptions.
35. Match types of active transport to their correct descriptions.
36. Complete statements that describe the process of cell growth.
37. Describe the types of cell reproduction.
38. Describe the process in which the genetic makeup of a cell can be changed.
39. List the sources of mutation-causing conditions.
40. Match the types of cellular respiration to their correct descriptions.
41. Arrange in order the levels in the taxonomy system used to classify organisms.
42. Match the types of relationships between organisms to their correct descriptions.
43. Describe the classes of microorganisms.
44. Label the classes of microorganisms as classified by their shape.
45. Define the terms *resident flora* and *transient flora.*
46. Describe the purpose of a gram stain.
47. Complete statements that describe the characteristics of bacteria.
48. Complete statements that describe the characteristics of rickettsiae.
49. Complete statements that describe the characteristics of viruses.
50. Complete statements that describe the characteristics of protozoa.
51. Complete statements that describe the characteristics of fungi and algae.
52. Complete statements that describe common parasites that afflict humans.

Application: What the student should be able to do

53. Practice critical thinking: complete biochemistry and microbiology case studies. (Assignment Sheet 1)

Module 3: Infection, Immunology, and Sanitation

Related information: What the student should know

1. Define the term *infection.*
2. Complete statements that describe the effects of infection on a human host.
3. Complete statements that describe methods used to reduce the spread of infection.
4. Match types of infections and diseases to their correct descriptions.
5. Define the phases in the course of a disease.
6. Complete statements that describe the role of the body's portals of entry and portals of exit in the spread of infectious diseases.
7. List sources of the microorganisms that cause infectious diseases.
8. List the factors that determine whether a pathogen will cause a disease in a host's body.
9. Define the factors that influence the virulence of a pathogen in a host's body.
10. State the functions of the body's physical barriers to infection.
11. State the functions of special structures, chemicals, and actions within the body that provide protection against infection.
12. Define the term *immunology.*
13. Define the types of immunity.
14. Define the types of cellular and tissue defense-mechanism processes the body uses against disease and infection.
15. Match types of white blood cells to their correct descriptions.
16. Describe the stages of the interferon response.
17. Describe the stages of phagocytosis.
18. Distinguish between the definitions of a T cell and a B cell.
19. Match types of T cells and B cells to their correct functions.
20. Distinguish between descriptions of the types of immunity development in the serum-protein response.
21. Describe the stages of cell-mediated immunity development in the serum-protein response.
22. Describe the stages of humoral-mediated immunity development in the serum-protein response.
23. Define the phases of the antibody-production cycle that follows the body's exposure to an antigen.
24. Describe the stages of the inflammatory reaction.

Module 3: Infection, Immunology, and Sanitation (continued)

Related information: What the student should know (continued)

25. Match types of vaccines to their correct definitions.
26. Define the term *hypersensitive response.*
27. Define the types of hypersensitive responses.
28. Match methods used to control the spread of microorganisms to their correct definitions.
29. State reasons certain industries must control the growth of microorganisms.
30. Describe the factors that determine the effectiveness of an antimicrobial procedure.
31. Match types of antimicrobial-control methods to their correct descriptions.
32. List factors that contribute to the spread of nosocomial infections.
33. Match organisms that cause common nosocomial infections to the infections they cause.
34. Describe types of patient isolation used in health-care facilities.
35. Complete statements that describe recommended precautions and guidelines used in surgical suites to reduce the spread of infection.

Application: What the student should be able to do

36. Practice critical thinking: complete a case study on immunity and infection. (Assignment Sheet 1)

Module 4: Tissues, Membranes, and Wound Healing

Related information: What the student should know

1. Define the term *tissue.*
2. Match the basic types of tissue to their correct descriptions.
3. State the functions of the basic types of tissue.
4. Complete statements that describe the characteristics of the epithelium.
5. Define the types of epithelial tissue as classified by shape.
6. Define the types of epithelial tissue as classified by tissue-layer arrangement.
7. Match the classes of epithelial tissue to their correct functions.
8. Match the types of connective tissue to their correct functions.
9. Define the basic types of nerve tissue.
10. State the functions of the basic parts of a neuron.

Module 4: Tissues, Membranes, and Wound Healing (continued)

Related information: What the student should know (continued)

11. Complete statements that describe how neurons function in the nervous system.

12. State the functions of the four types of neuroglia.

13. Describe the factors that determine muscle-tissue classifications.

14. Match types of muscle contractions to their correct definitions.

15. Define the term *neuromuscular excitability.*

16. Complete statements that describe the neuromuscular-excitability response.

17. State the locations of the main types of membranes.

18. State the functions of the main types of membranes.

19. Define the term *organ.*

20. List the types of tissues and membranes found in selected organs.

21. Complete statements that describe how organ systems function.

22. Match terms that describe abnormalities in organ development to their correct definitions.

23. Define the types of injuries that can damage tissue.

24. Match the types of traumatic wounds to their correct definitions.

25. Describe the causes of the characteristics of the inflammation response.

26. Complete statements that describe the phases in the body's healing response.

27. Distinguish among statements that describe the types of treatment responses in the treatment of wounds.

28. Describe the factors that affect the wound-healing process.

29. Define factors that present possible complications to the wound-healing process.

30. Match the classifications of surgical wounds to their correct descriptions.

Application: What the student should be able to do

31. Practice critical thinking: complete case studies that consider how tissues and membranes function to maintain the body as a whole. (Assignment Sheet 1)

Academic and Workplace Skill Classifications and Definitions

Skill groups	Sub skills	Definitions
Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
	Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
	Arithmetic/mathematics	Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques
	Science	Applying knowledge learned through study and practice that is based on scientific principles, methods, and techniques
	Listening	Receiving, interpreting, and responding to oral messages and other cues
	Speaking	Communicating a thought, idea, or fact verbally in a clear, concise manner
Thinking skills	Creative thinking	Using imagination to generate new ideas
	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative
	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
	Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
	Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
Personal management skills	Responsibility	Exerting a high level of effort towards goal attainment, working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Self-esteem	Developing self-confidence and maintaining a positive self-image
	Career awareness, development, and mobility	Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress
	Integrity/honesty	Choosing an ethical course of action when faced with making a decision that may break with personal or societal values and recognizing the impact of violating these beliefs and codes on an organization, self, and others
	Organizational effectiveness	Adapting to the organization's goals, values, culture, and traditional modes of operation
Interpersonal skills	Teamwork	Working cooperatively with others to reach a common goal
	Coaching	Helping others learn new skills

Skill groups	Sub skills	Definitions
Interpersonal skills (continued)	Leadership	Communicating ideas to justify position; accepting responsibility for others; and encouraging, persuading, convincing, or otherwise motivating an individual or group
	Negotiation	Resolving conflict between two or more individuals through discussion and compromise
	Customer service	Working and communicating with customers to satisfy their expectations
	Cultural diversity	Working well with men and women and with a variety of ethnic, social, or educational backgrounds
Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy
	Organization and storage	Organizing, processing, and maintaining written or computerized records and other forms of information in a systematic way
	Interpretation	Selecting and analyzing information and communicating the results to others
	Processing	Using computers to acquire, organize, analyze, and communicate information
Systems	Interrelationships	Knowing how social, organizational, and technological systems work and operate effectively
	Monitoring	Distinguishing trends, predicting impact of actions on system operations, diagnosing deviations in systems' performance, and correcting malfunctions
	Modification and design	Making suggestions to modify existing systems to improve products or services, and developing new or alternative systems
Technology	Selection	Choosing procedures, tools, or equipment including computers and related technologies
	Application	Demonstrating proper procedures for setting up and operating equipment
	Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment, including computers and other technologies
Resources	Time	Selecting relevant, goal-related activities; ranking them in order of importance; allocating time; and understanding, preparing, and following schedules
	Money	Using or preparing budgets, making forecasts, keeping records, and making adjustments to meet objectives
	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Human resources	Assessing skills and distributing work accordingly, evaluating performance and providing feedback

Related Academic and Workplace Skills List

Module 1: Organization of the Human Body

Practice Critical Thinking: Use Directional Terms to Describe Surgical Incisions (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems
		Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Information	Interpretation	Selecting and analyzing information and communicating the results to others
Define Medical Terms (A.S. 2)	Basic skills	Reading	Comprehending written information and analyzing and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Information	Acquisition and evaluation	Obtaining data from existing sources and evaluating its accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others

Module 2: Biochemistry and Microbiology

Practice Critical Thinking: Complete Biochemistry and Microbiology Case Studies (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
		Science	Applying knowledge learned through study based on scientific principles
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results

Module 2: Biochemistry and Microbiology (continued)

		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge
		Reasoning	Applying a principle underlying the relationship between two or more objects when solving a problem
	Information	Acquisition and evaluation	Obtaining data from existing sources and evaluating its accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others

Module 3: Infection, Immunology, and Sanitation

Practice Critical Thinking: Complete a Case Study on Immunity and Infection (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner
		Science	Applying knowledge learned through study that is based on scientific principles
	Thinking skills	Creative thinking	Using imagination to generate new ideas
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge
		Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem
	Information	Acquisition and evaluation	Obtaining data from existing sources and evaluating its accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
		Processing	Using computers to acquire, organize, analyze, and communicate information
	Technology	Selection	Choosing procedures, tools, or equipment including computers and related technologies

Module 4: Tissues, Membranes, and Wound Healing

Practice Critical Thinking: Complete Case Studies that Consider How Tissues and Membranes Function to Maintain the Body as Whole (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
		Science	Applying knowledge learned through study based on scientific principles
	Thinking skills	Problem solving	Recognizing and defining problems

Module 4: Tissues, Membranes, and Wound Healing (continued)

	Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge
	Reasoning	Applying a principle underlying the relationship between two or more objects when solving a problem
Information	Acquisition and evaluation	Obtaining data from existing sources and evaluating its accuracy
	Interpretation	Selecting and analyzing information and communicating the results to others

MODULE SET I:
Introduction to Anatomy and Physiology

Module 1: Organization of the Human Body

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INSTRUCTIONAL PLAN

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

PREPARATION

- Read the module in the student edition.
- Review the Teaching Suggestions section that follows on page 4 of the Suggested Activities.
- Review the Resources Used in Developing This Module section that follows on page 5 of the Suggested Activities.
- Review the Suggested Web Sites section that follows on page 5 of the Suggested Activities.
- Review the additional resources that follow: transparency masters, Written Test, crossword puzzles, and Module Review.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Make transparencies from the transparency masters.
- Select web sites to be inserted on the Learning Activities Sheet in the student edition.
- Select additional activities to be inserted on the Learning Activities Sheet in the student edition.
- Copy the Written Test, crossword puzzles, and Module Review for distribution to your students.
- Prepare supplemental resources for use by your students.

DELIVERY AND APPLICATION

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.

EVALUATION

- Give the Written Test. Reteach and retest as required.
- Review with students the remaining components in the student edition: student supplements, assignment sheets, etc.
- Have students complete the assignment sheets.
- Give the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Reteach and retest as required.

TEACHING SUGGESTIONS

✔ **NOTE:** This module has two primary purposes: to introduce students to the organization of the human body and to begin to build the students' anatomy and physiology vocabularies. Look for opportunities to reinforce both goals as you present the module and continue into the other modules in this course.

- Use crossword puzzles 1 through 4 to help reinforce the terms in the associated objectives.
- Play a game of "Instructor Says" in which the instructor tells the students to touch a body part relative to another one. For example, the instructor may say, "Instructor says to touch a part superior to the left elbow." If the teacher does not say "instructor says," then the students should not follow through with the command.
- Using the transparencies or other illustrations, ask the students to indicate planes and then name major organs that are intersected by the planes—for example: "a saggital plane that divides the umbilical and left lumbar abdominal regions."
- Use a Visible Man/Visible Woman to have the students identify organs and structures in body regions and abdominal regions.
- Have a scavenger hunt in which the students have to find another example of the terms provided in Student Supplement 1, excluding those given in the student supplement. Medical dictionaries, periodicals, or other publications can be used.
- Provide the students with medical dictionaries and have them look up the examples given in Student Supplement 1.
- Play a game of "Twister" using the terms in Student Supplement 2.
- Using terms from Student Supplement 2 or other sources, provide the students with medical terms and ask them what organ system or systems are likely to be involved. For example, "renal failure" is most likely to involve the kidneys.
- Have students use the flash-card sets available with this curriculum series as a learning aid for the information presented in Student Supplement 1 and Student Supplement 2.

RESOURCES USED IN DEVELOPING THIS MODULE

- *Anatomy and Physiology*. Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1993.
- *Core Curriculum for Surgical Technology*, 4th ed. Englewood, CO: Association of Surgical Technologists, Inc., 1996.
- Gylys, Barbara A., and Regina Masters. *Medical Terminology Simplified*, 2nd ed. Philadelphia: F.A. Davis Company, 1998.
- Gray, Henry. *Gray's Anatomy*, 15th ed. New York: Gramery Books, 1977.
- Kwon-Chung, K. J., and John E. Bennett. *Medical Mycology*. Philadelphia: Lea and Febiger, 1992.
- Scanlon, Valerie C. *Essentials of Anatomy and Physiology*, 3rd ed. Philadelphia: F.A. Davis Company, 1999.
- Sherris, David A., and Eugene B. Kern. *Basic Surgical Skills*. Rochester, MN: Mayo Foundation for Medical Education and Research, 1999.
- Thibodeau, Gary A., and Kevin T. Patton. *Anatomy and Physiology*, 4th ed. St. Louis: Mosby, Inc., 1999.

SUGGESTED WEB SITES*

✔ **NOTE:** The following web sites offer general information about anatomy and physiology and generally cover more than one body system. Later modules list sites specific to the systems and disorders presented in that module. These sites can be used in a general way with the first four modules included in Module Set I and for specific portions of the sites as they relate to the systems covered in later modules in Module Set II.

- http://harveyproject.org

  The Harvey Project is an international collaboration of educators, researchers, physicians, students, programmers, instructional designers, and graphic artists working together to build interactive, dynamic human physiology course materials on the World Wide Web. Materials produced by the Harvey Project are available free to educational institutions. The site is constantly updated and should be checked often and browsed for overall content. The address provided is for the home page. By clicking the WEB button, you will be taken to an index of links divided into categories such as general physiology and specific systems. The number of links in each category is indicated in parentheses after the topic.

- http://www.hapsweb.org/

  The Human Anatomy and Physiology Society (HAPS) was founded to promote communications among teachers of human anatomy and physiology in colleges, universities, and related institutions; to present workshops and conferences where members can obtain information about the latest developments in the health and sciences fields; and to encourage educational research and publication by HAPS members. The site contains information about society resources, including a newsletter, publications, and resources on the World Wide Web.

- http://www.niagra.edu/~bcliff/hapcstop.html

  This site contains case studies for all AST subject areas. The case studies are free to use as long as their source is acknowledged.

- http://www.nim.nih.gov/research/visible/visible_human.html

  The Visible Human Project's objective is to create complete, anatomically detailed, three-dimensional representations of the normal male and female human bodies. The site contains CT, MR, and cryosection images of male and female cadavers. The male is sectioned at one-millimeter intervals, while the female is sectioned at one-third-of-a millimeter intervals.

- http://edtech.nepean.uws.edu.au/science/ap/index.html

  This anatomy and physiology resource page contains information, images, suggestions, tips, and stimuli to students preparing for a career in health services. Although based on Australian requirements, much of the information is useful for students in other nations.

- http://www.innerbody.com/htm/body.html

  This site provides a great deal of information on the human body in fun, interactive formats. There is a great deal of emphasis on terminology and body parts.

- http://www.orthop.washington.edu/Bone%20and%20Sources/Sources.idx.html

  Sponsored by the University of Washington, this site offers information on orthopedic-related subjects and links to similar sites.

- http://tray.dermatology.uiowa.edu/DermImag.htm

  This site offers many images of the skin and underlying tissues.

- http://www.ctru.auckland.ac.nz/atlas/intro/cardiac.htm

  This site offers an atlas that provides nearly 100 cross-sectional views of the cardiac anatomy created with an MRI scanner. The views are labeled and taken along different axes.

- http://www.prenhall.com/martini/

  This site is geared to five Prentice-Hall textbooks and offers a variety of self-grading quizzes, links to other web sites, a forum for student discussion, and other resources.

- http://www.heartsite.com/index.html

  Although designed for patients with heart-related complaints, this site contains a great deal of information about the heart and its disorders.

- http://www.merck.com/health/

  This site provides a general guide to health that addresses many of the disorders covered in this curriculum.

- http://www-sci.lib.uci.edu/~martindale/MedicalAnatomy.html

  This site provides a wealth of information and many useful graphics about human anatomy.

- http://www.uchsc.edu/sm/chs/gallery/gallery.htm

  This link goes directly to the gallery portion of the Visible Body Project at the University of Colorado.

- http://sln.fi.edu/biosci/biosci.html

  This site allows students to explore the heart, its structure and development, the flow of blood, and its relationship to other body systems. It also presents information about heart health and the history of heart science.

- http://www.maui.net/~jms/brainuse.html

  This site deals primarily with the brain and offers many useful graphics.

- http://www.cid.ch/DAVID/Mainmenu.html

  This is a rich gallery of CAT scans that can be explored through links to various sections of the body.

- http://www.meddean.luc/lumen/MedEd/GrossAnatomy/GA.html

  This site provides many images that include laboratory slides and anatomical cross-sections.

- http://www.med.umich.edu/lrc/Atlas/atlas.html

  ATLAS-plus integrates the use of digitized images, computer graphics, sound, animations, and textual information to teach basic concepts and principles of human anatomy through three courses: gross anatomy, histology, and embryology. The gross-anatomy course includes systemic components and dissection images.

- http://www.rad.washington.edu/anatomy/index.html

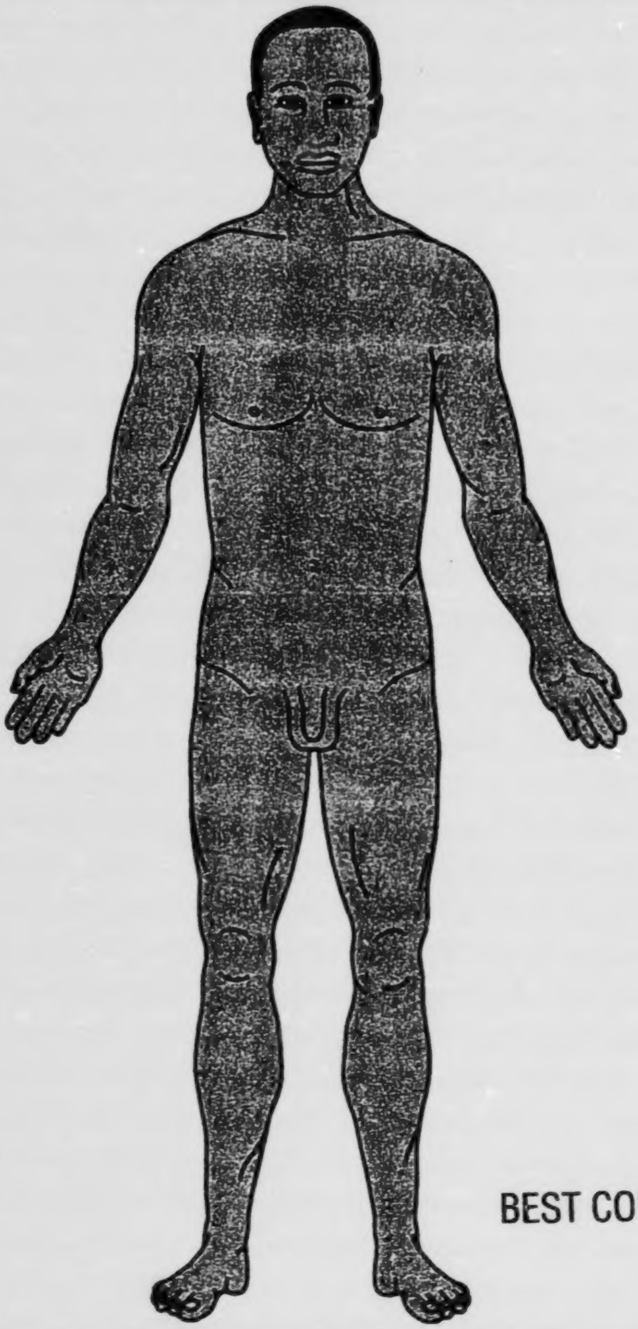
  This site features radiological images of the body and the skeletal system.

- http://www9.biostr.washingron.edu/da.html

  This site provides images and information in four areas: the brain, neuroanatomy, thoracic viscera, and the knee.

*Web-site addresses were accurate and all content on referenced web sites was appropriate during development and production of this product. However, web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all web sites prior to use.

Anatomical Position: Anterior View



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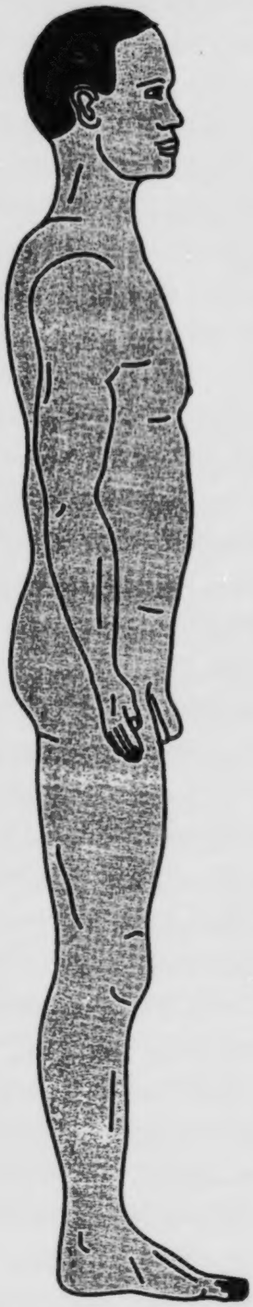
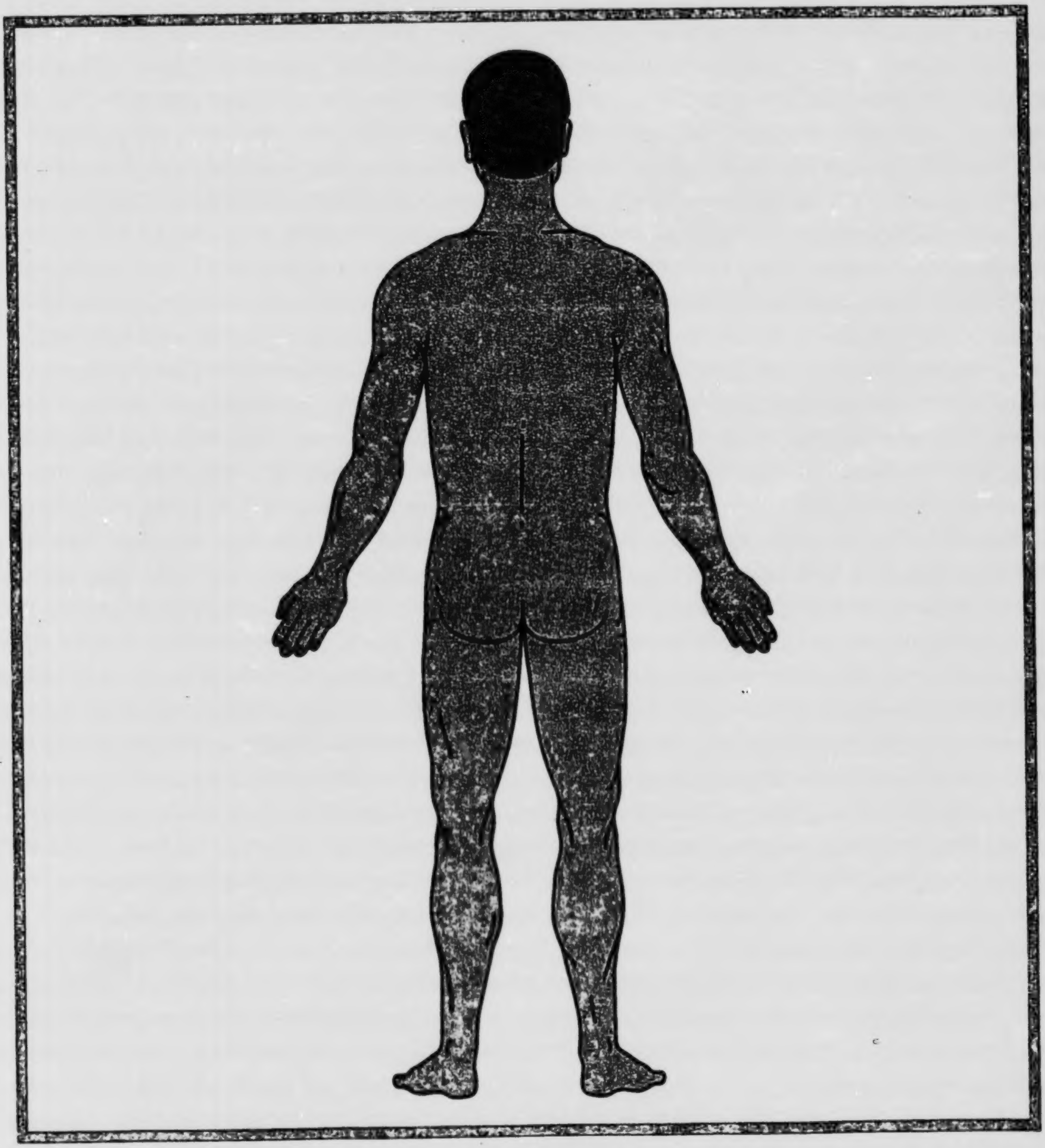
Anatomical Position: Lateral View



Anatomical Position: Posterior View



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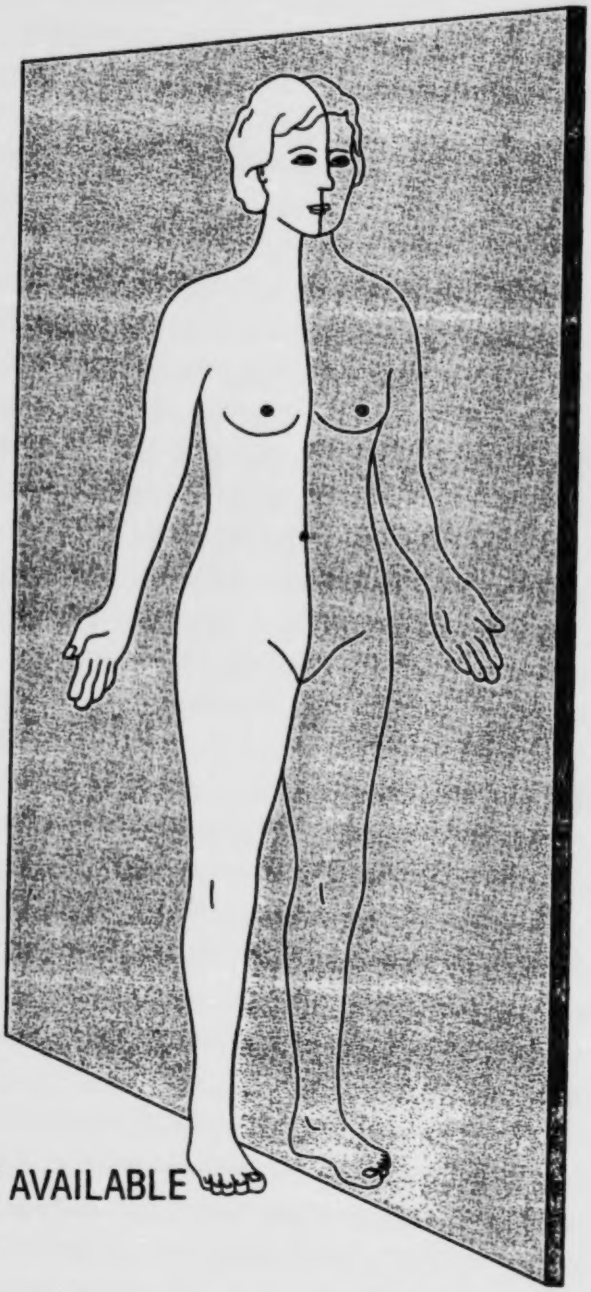
Common Body Planes: Median Plane



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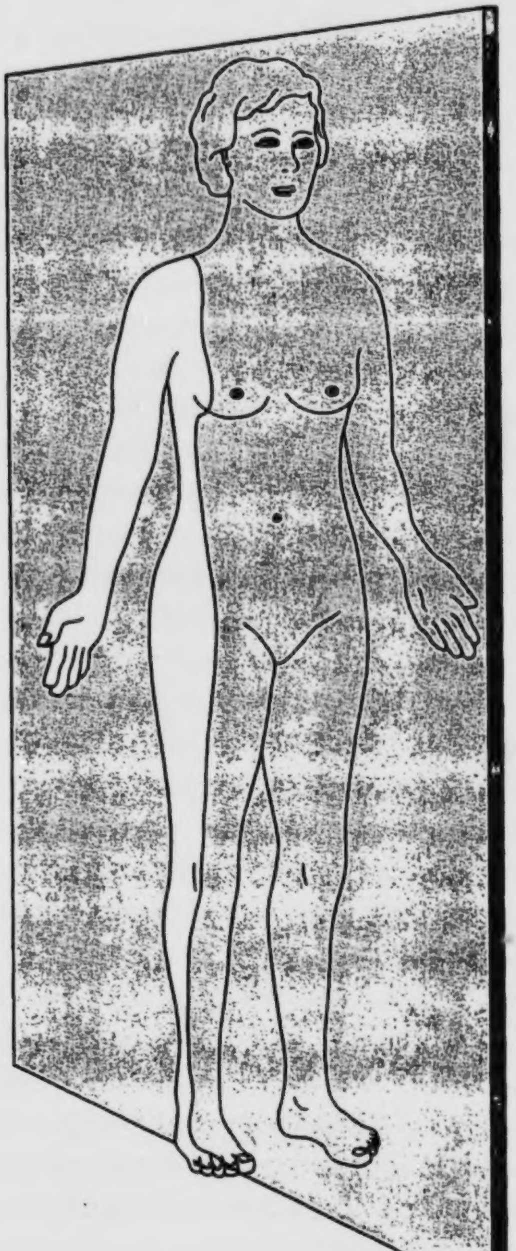
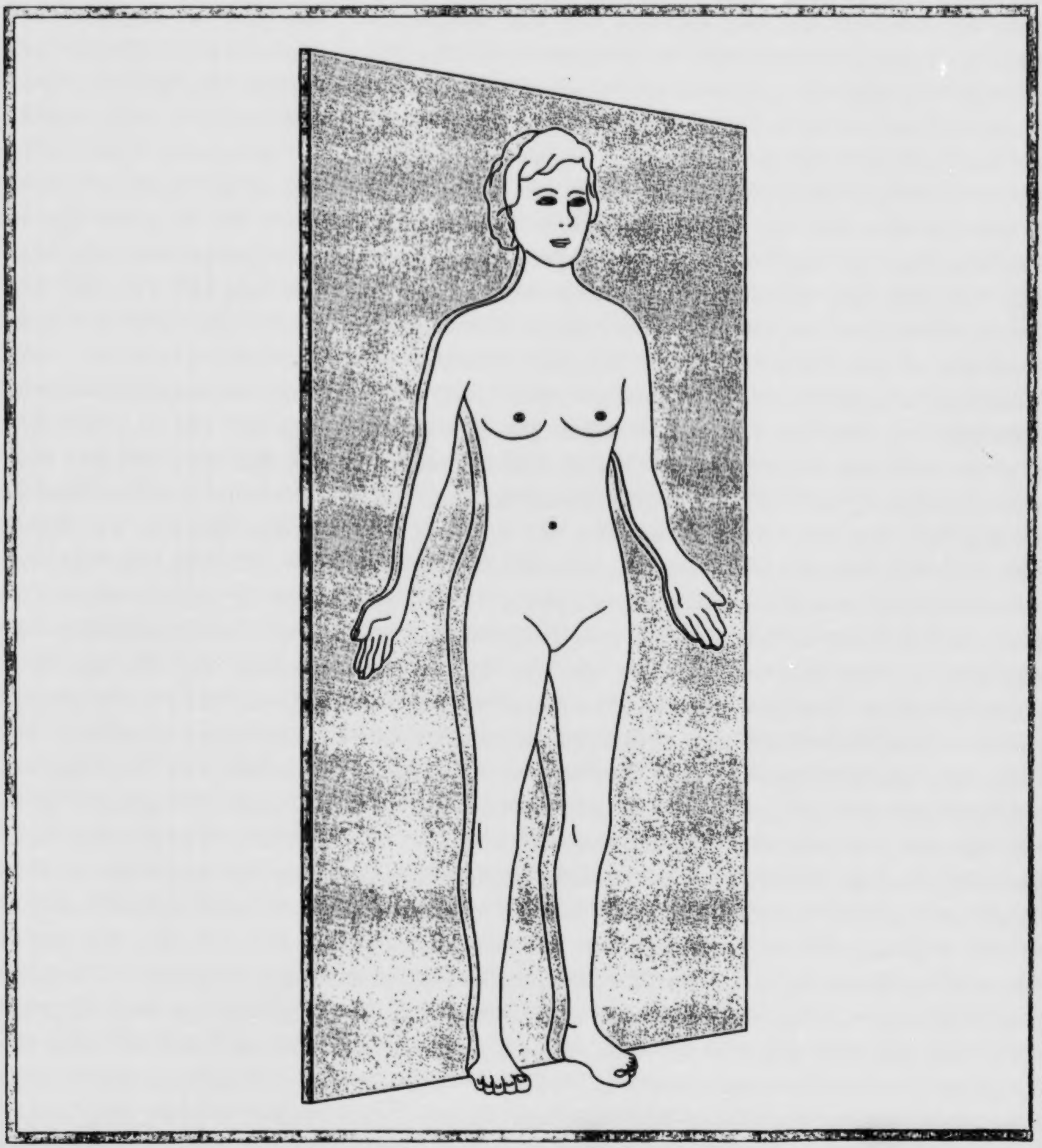
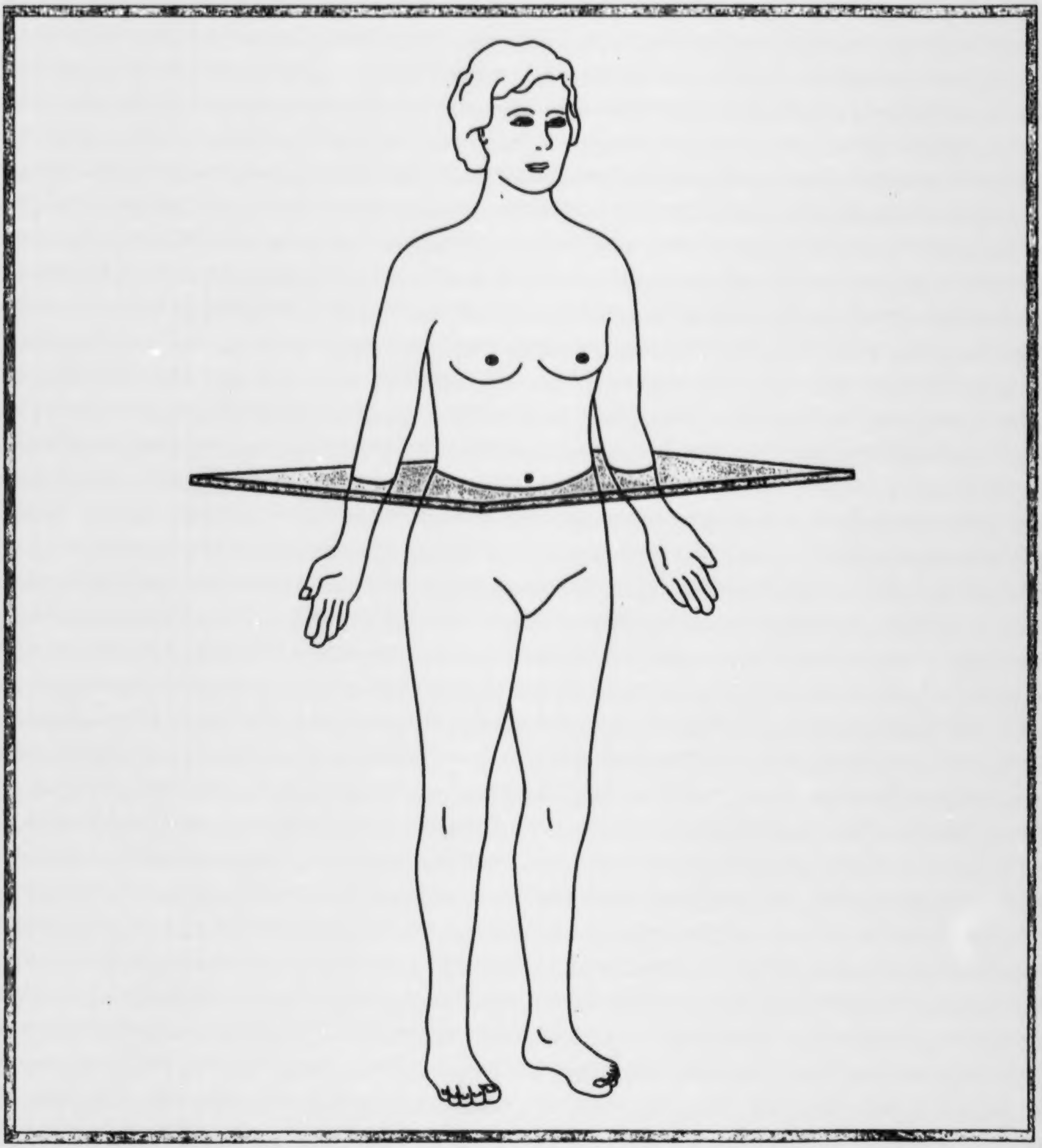
Common Body Planes: Sagittal Plane



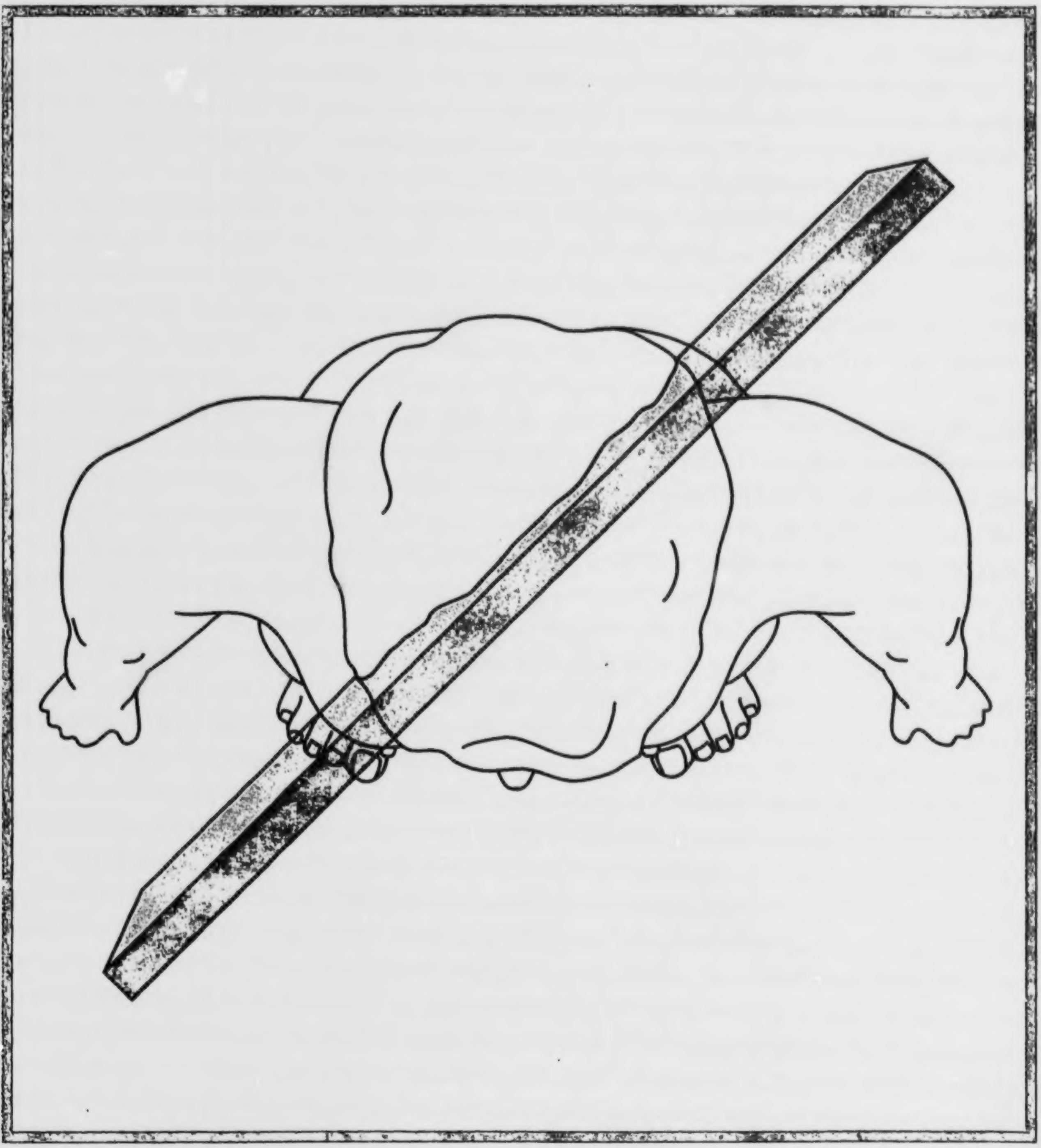
Common Body Planes: Coronal Plane



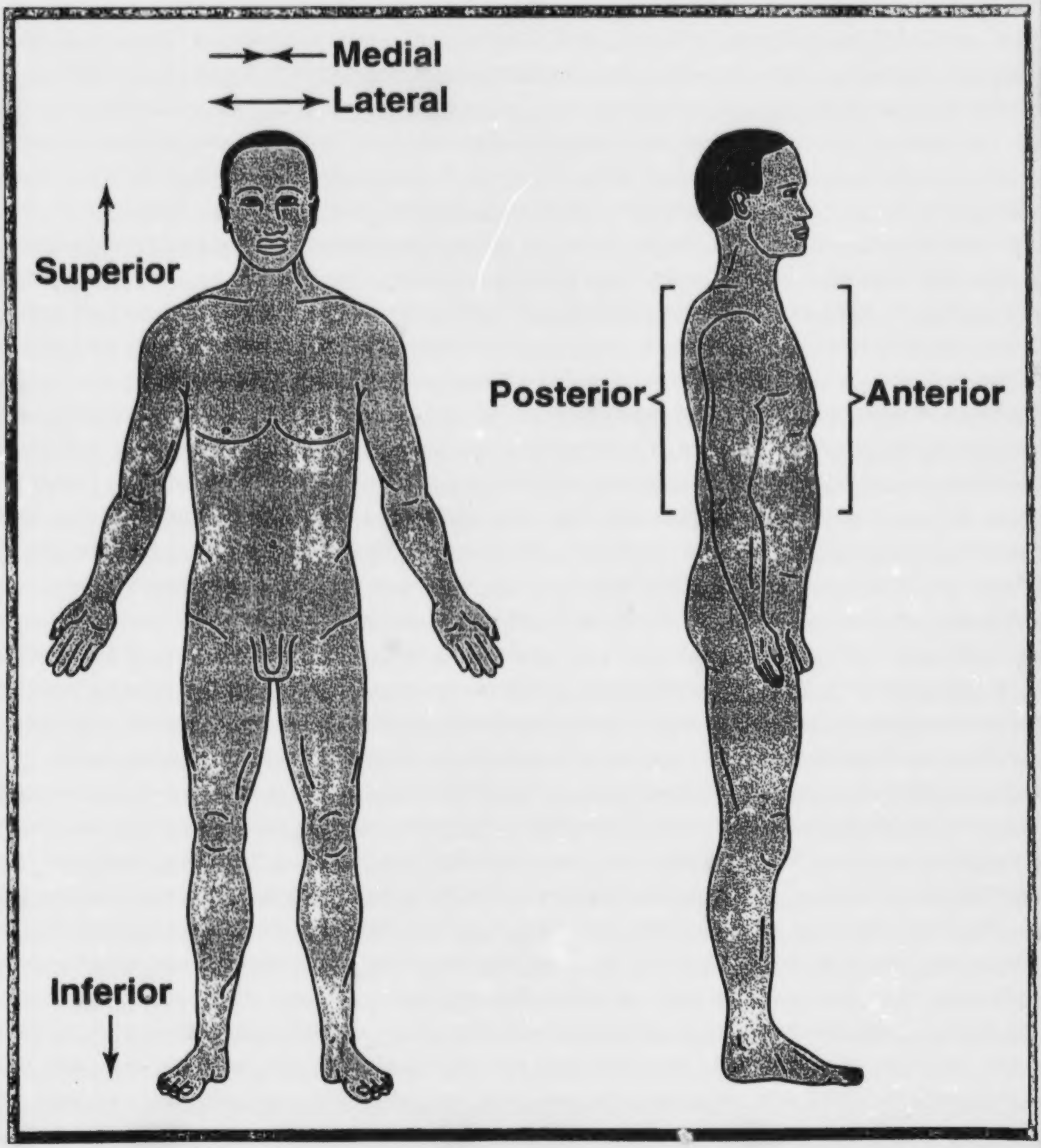
Common Body Planes: Transverse Plane



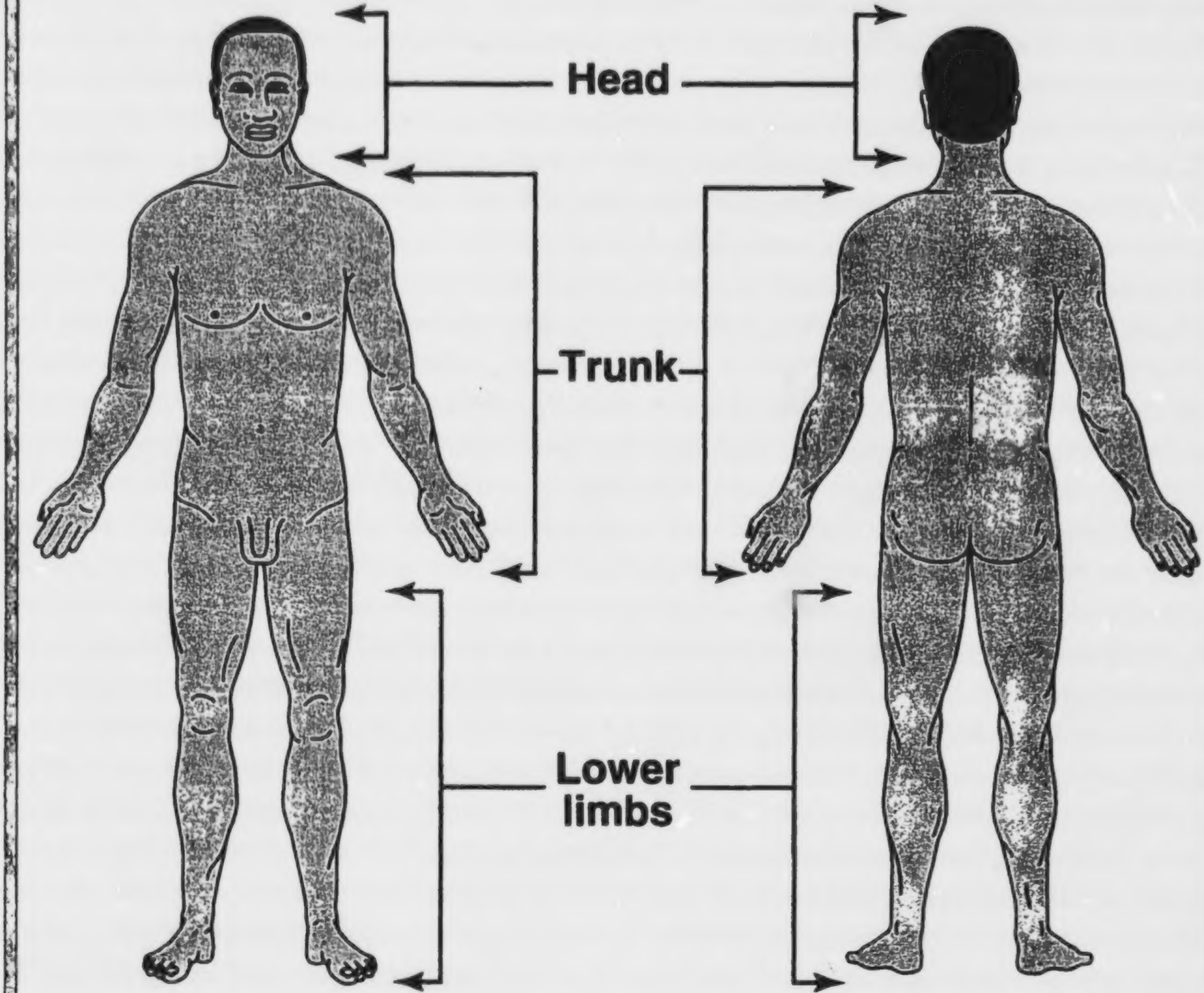
Common Body Planes: Oblique Plane



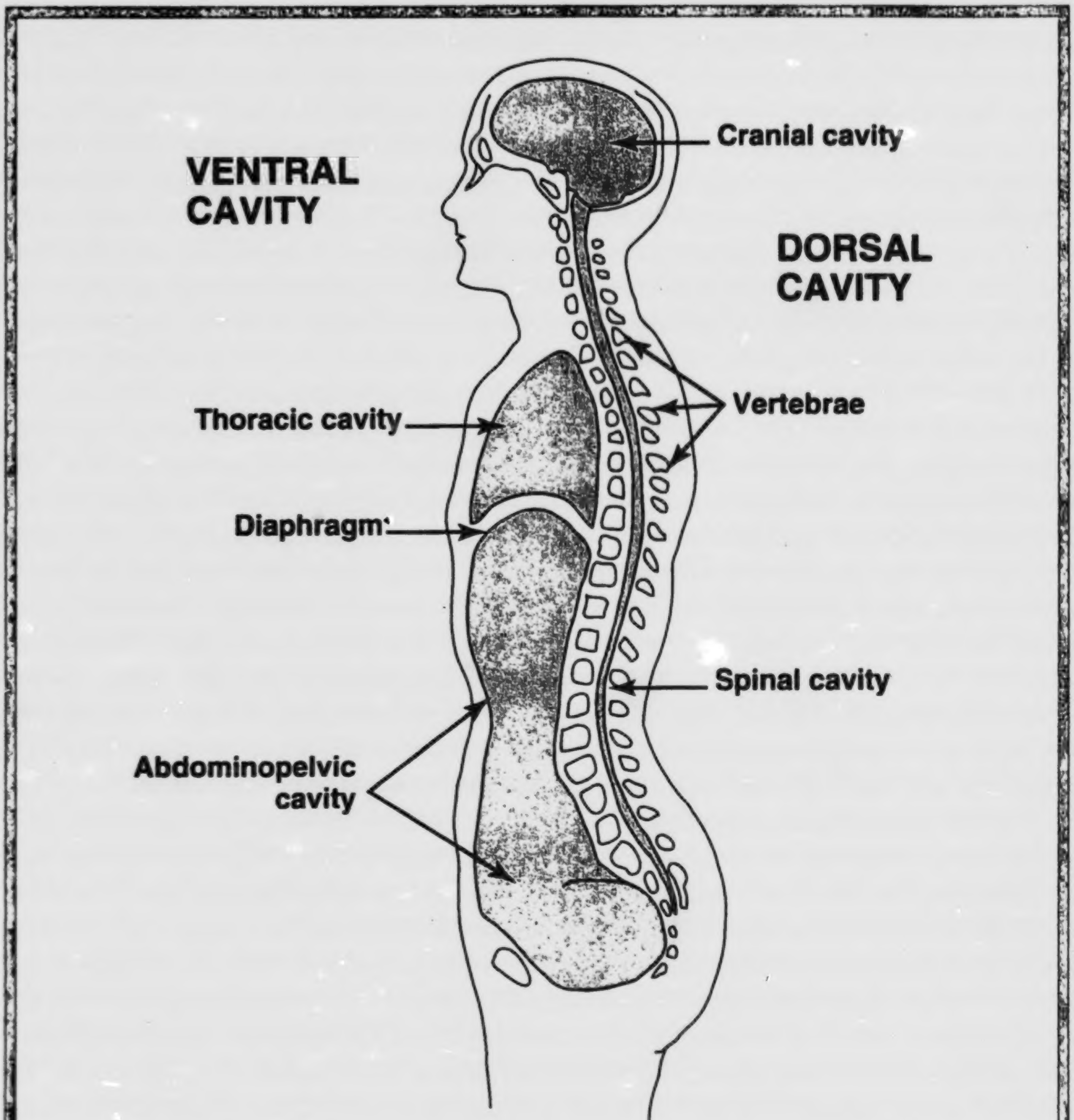
Directional Terms


Medial
Lateral
Superior
Inferior
Posterior
Anterior

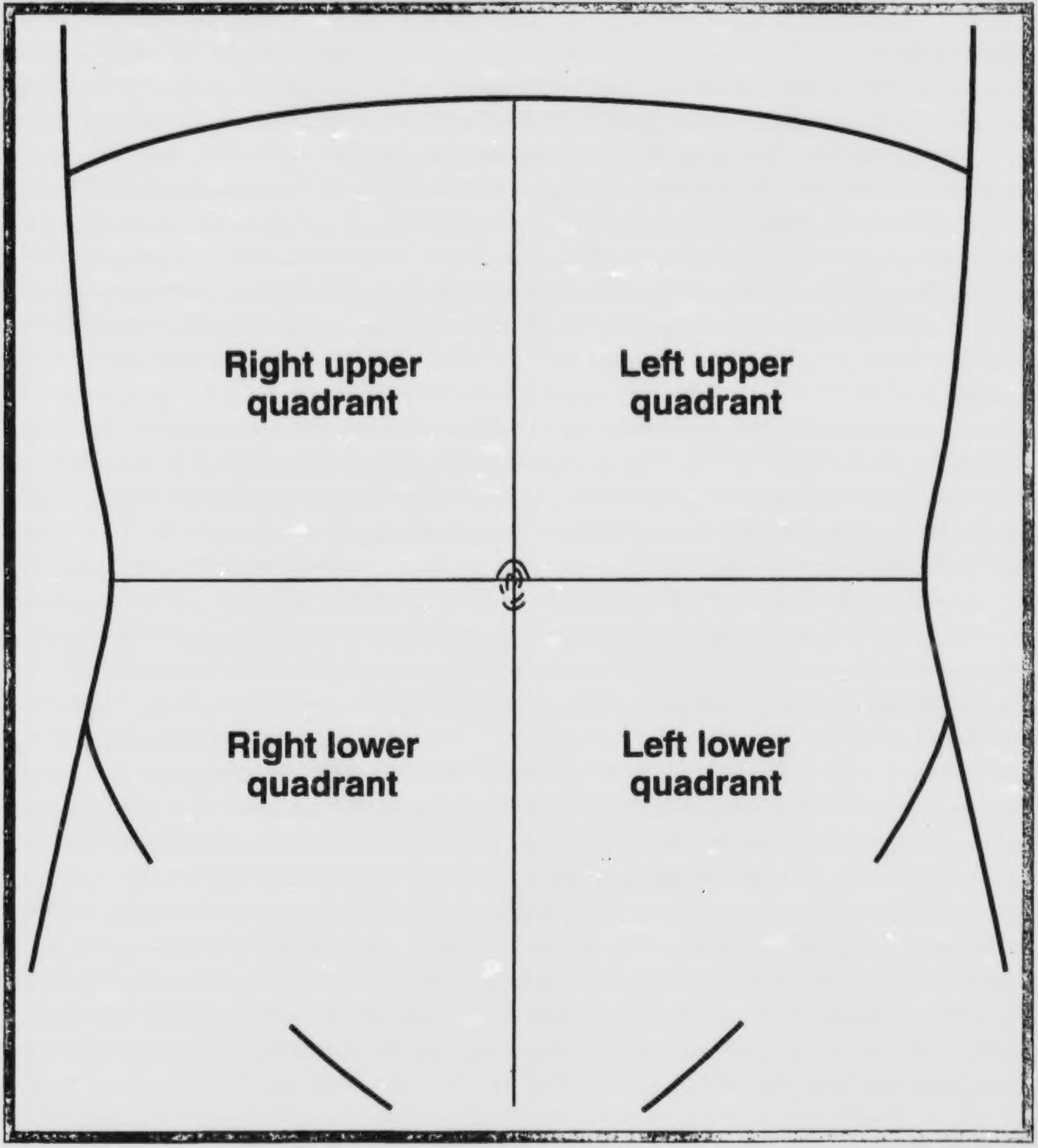
General Regions of the Body


Head
Trunk
Lower limbs

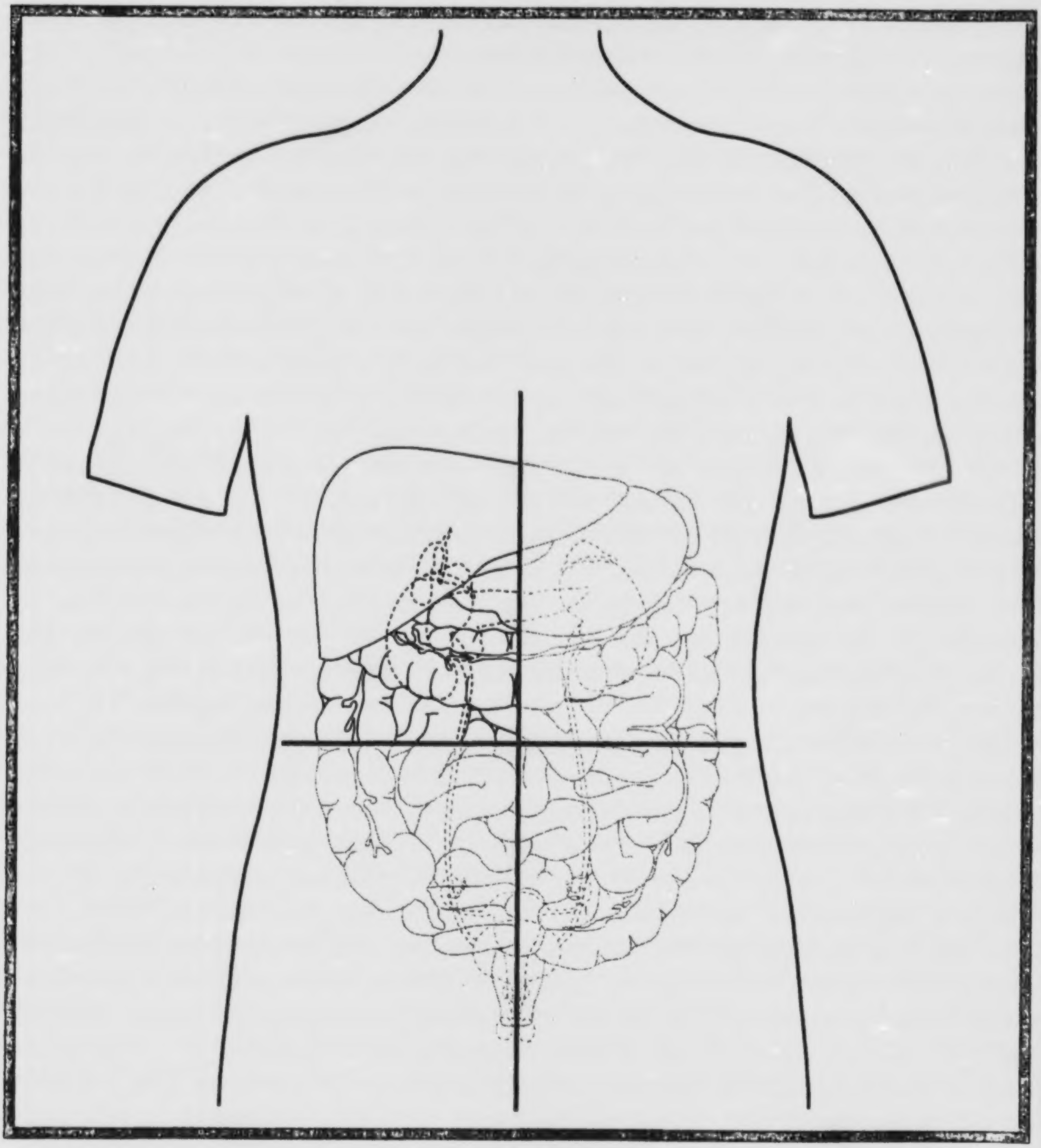
Major Body Cavities


VENTRAL CAVITY
Cranial cavity
DORSAL CAVITY
Vertebrae
Thoracic cavity
Diaphragm
Spinal cavity
Abdominopelvic cavity

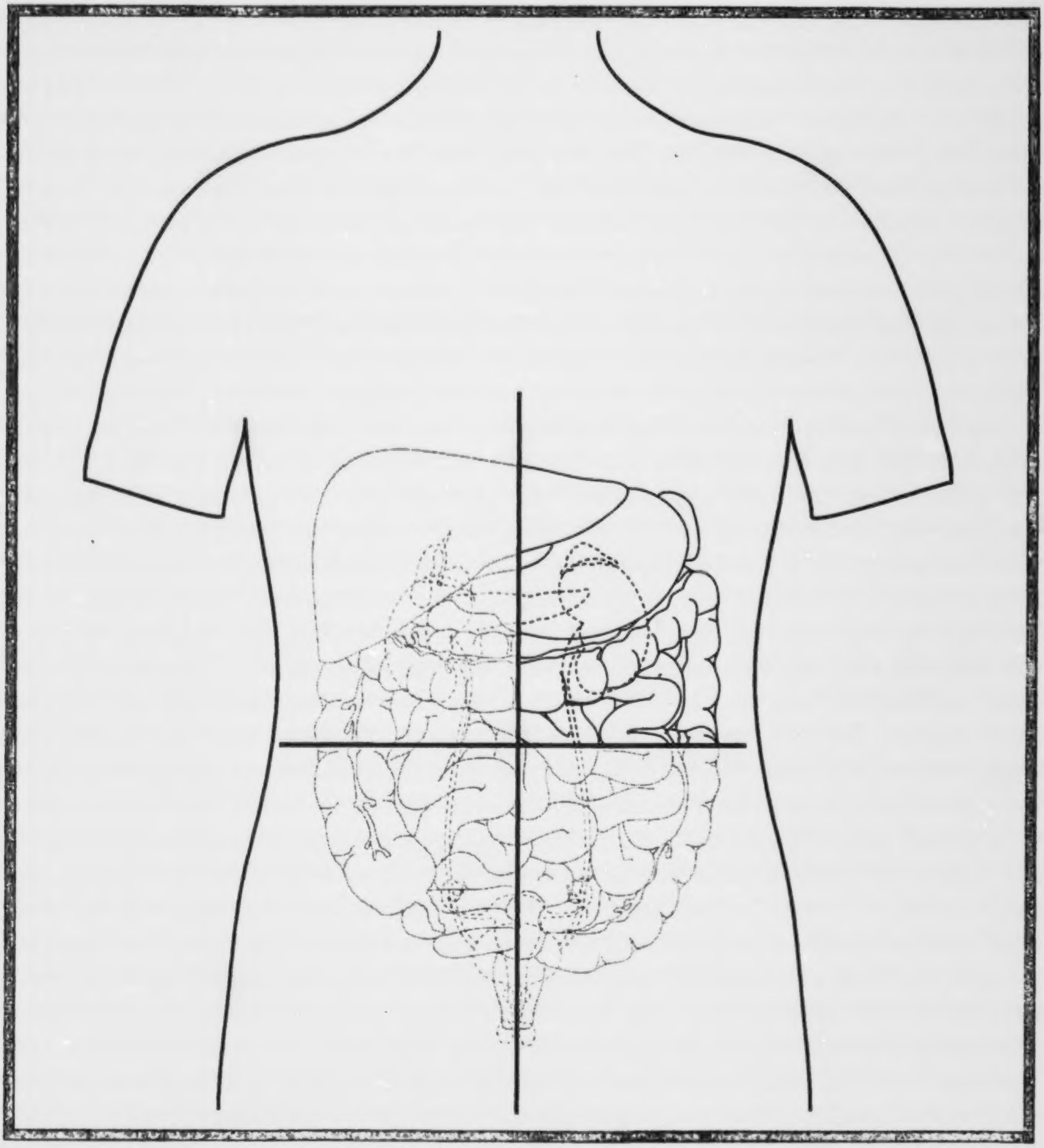
Quadrants of the Abdominopelvic Cavity


Right upper quadrant
Left upper quadrant
Right lower quadrant
Left lower quadrant

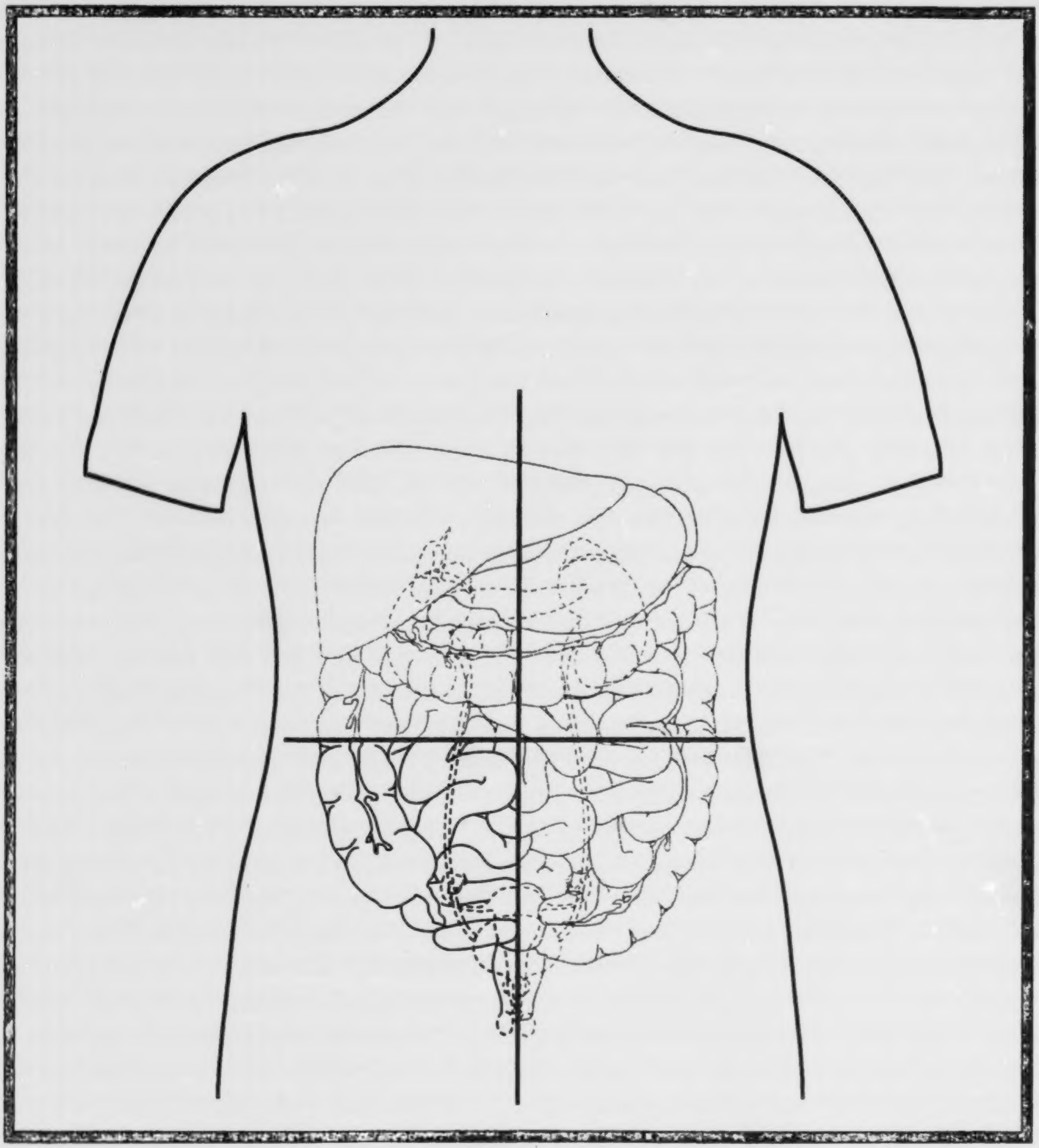
Major Organs of the Right Upper Abdominopelvic Cavity



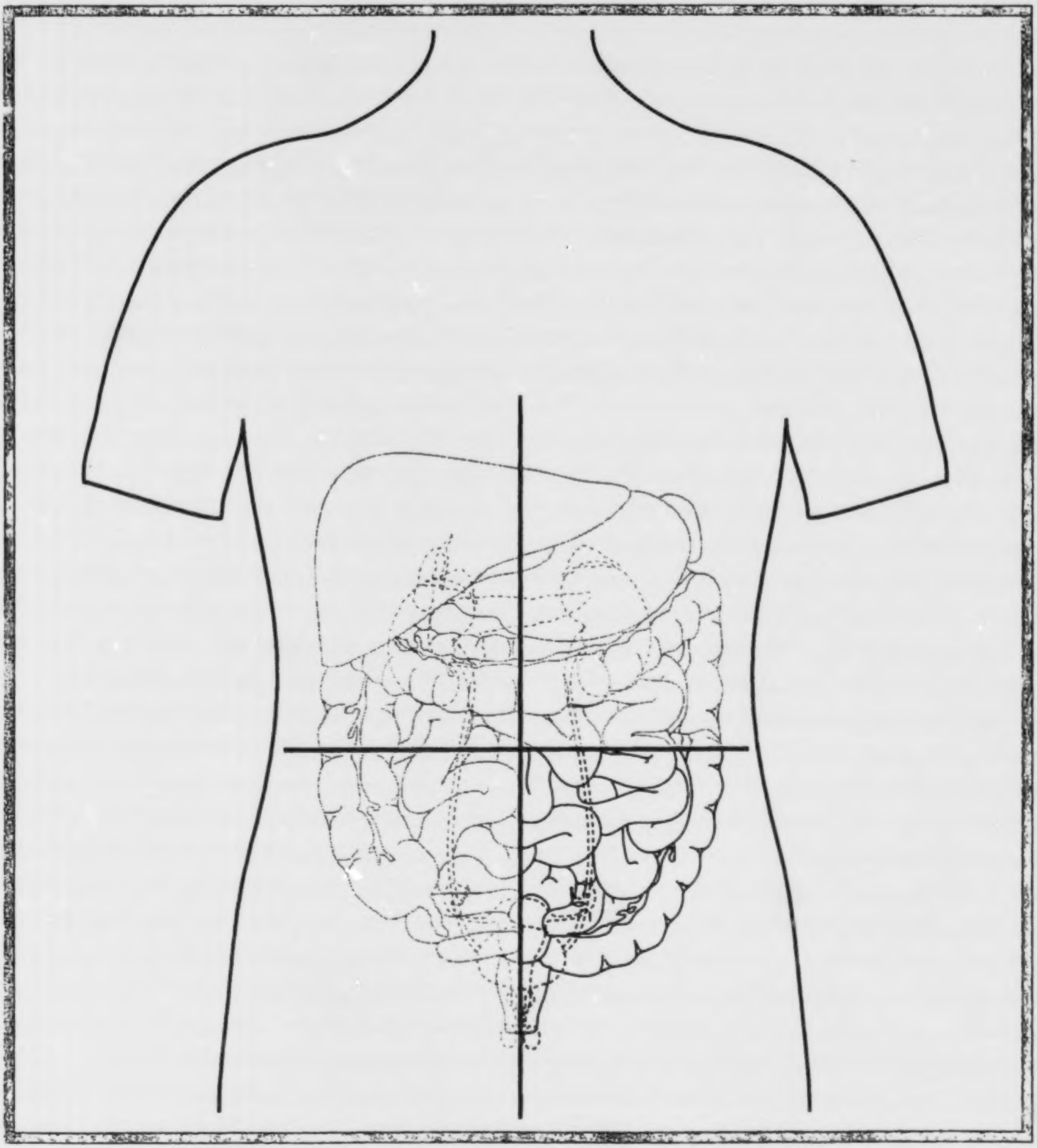
Major Organs of the Left Upper Abdominopelvic Cavity



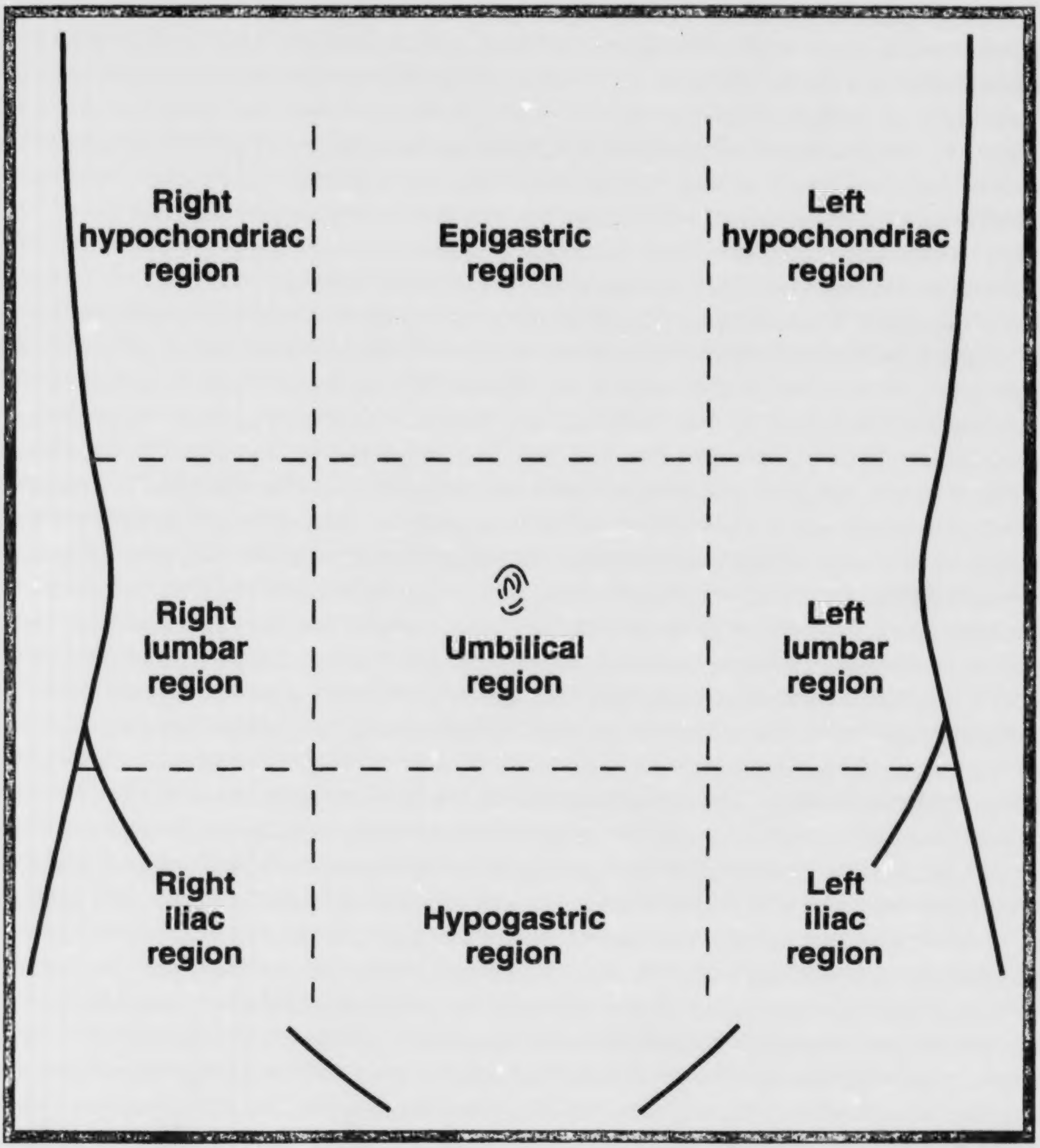
Major Organs of the Right Lower Abdominopelvic Cavity



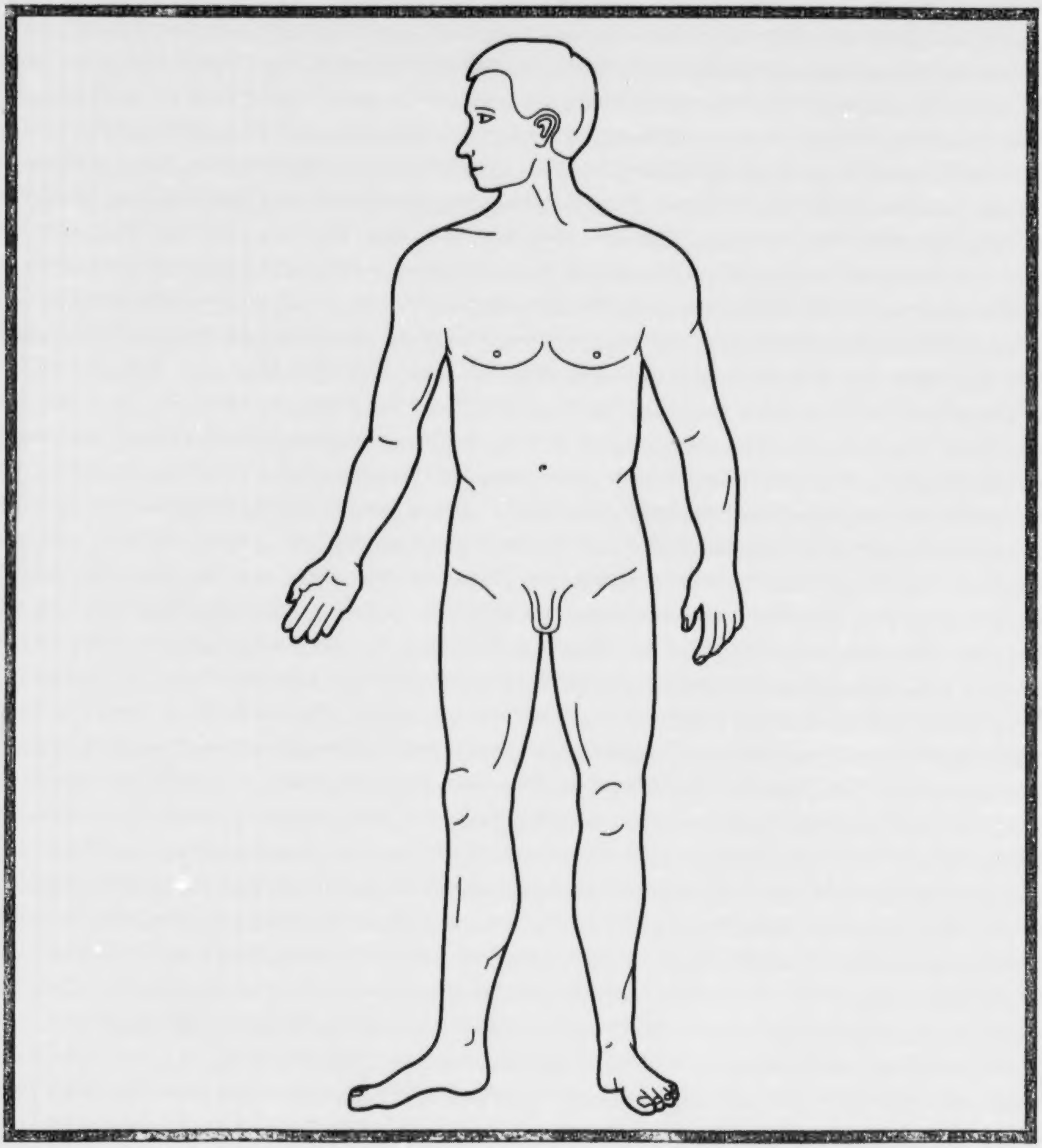
Major Organs of the Left Lower Abdominopelvic Cavity



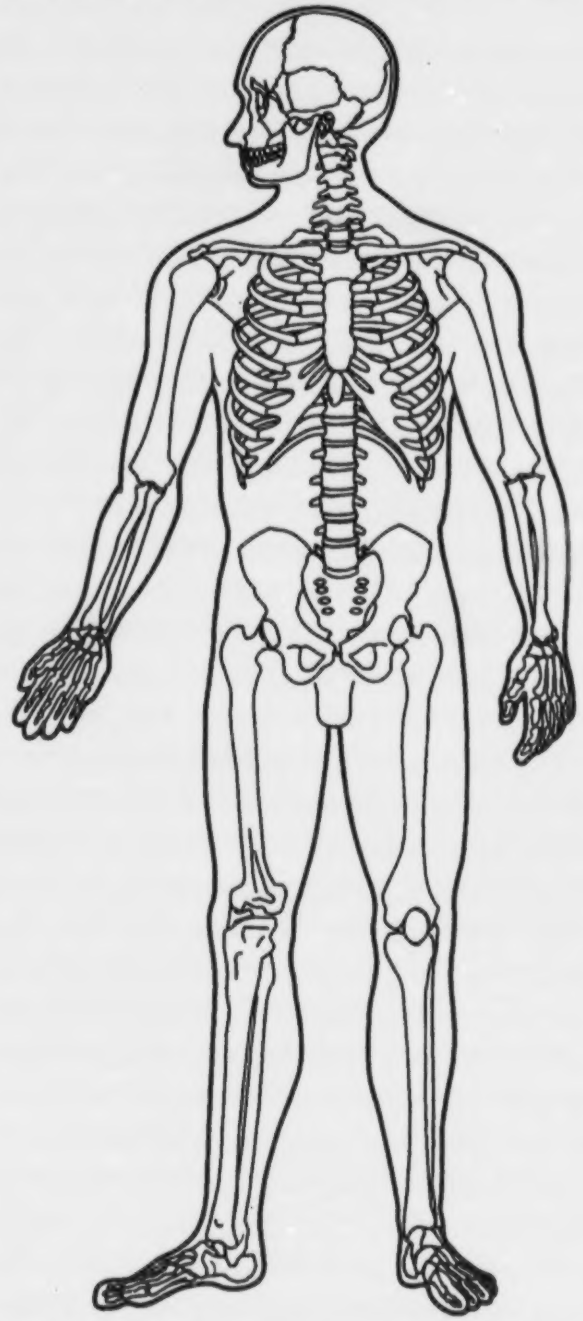
Nine Regions of the Abdomen


Right hypochondriac region
Epigastric region
Left hypochondriac region
Right lumbar region
Umbilical region
Left lumbar region
Right iliac region
Hypogastric region
Left iliac region

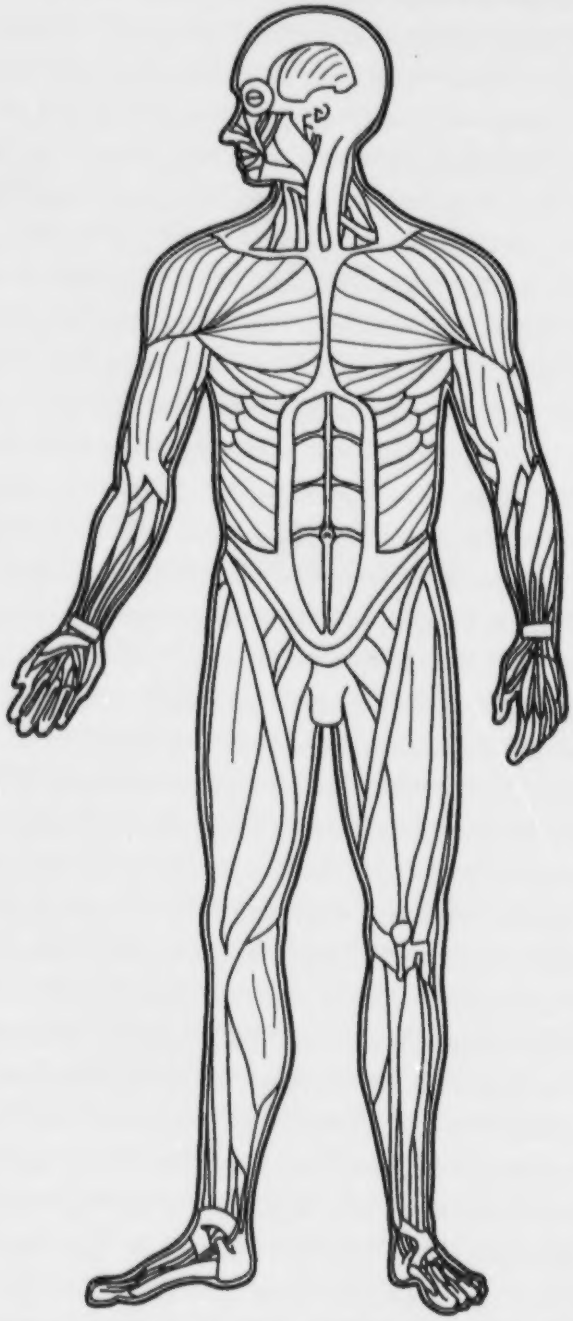
Integumentary System



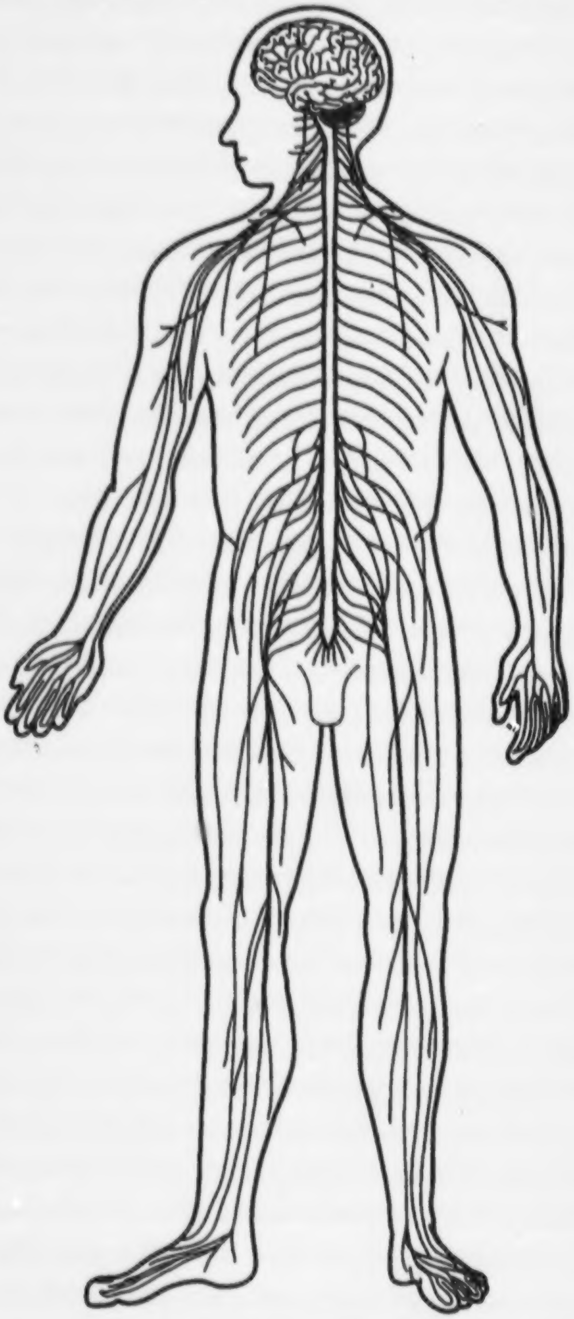
Skeletal System



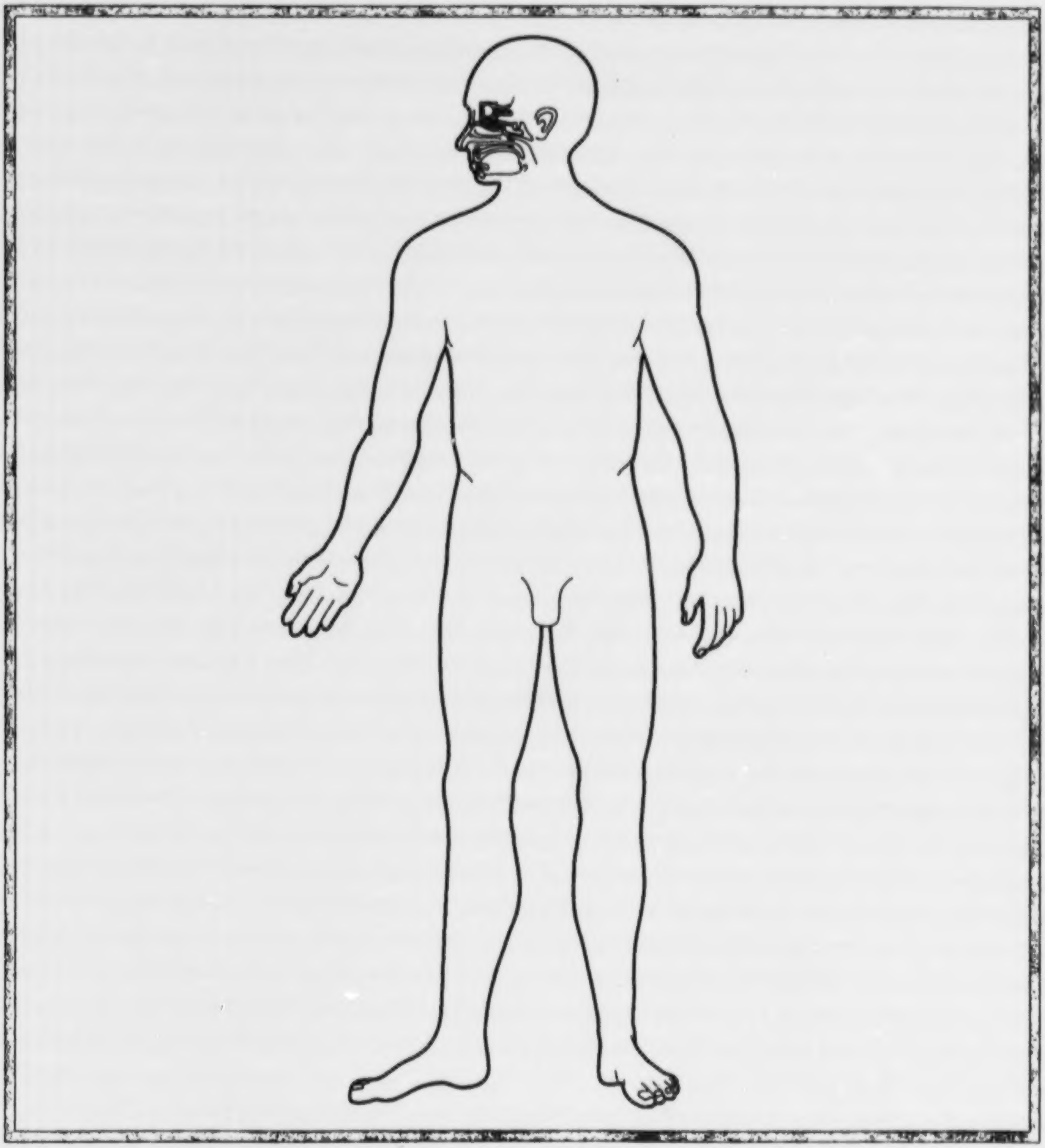
Muscular System



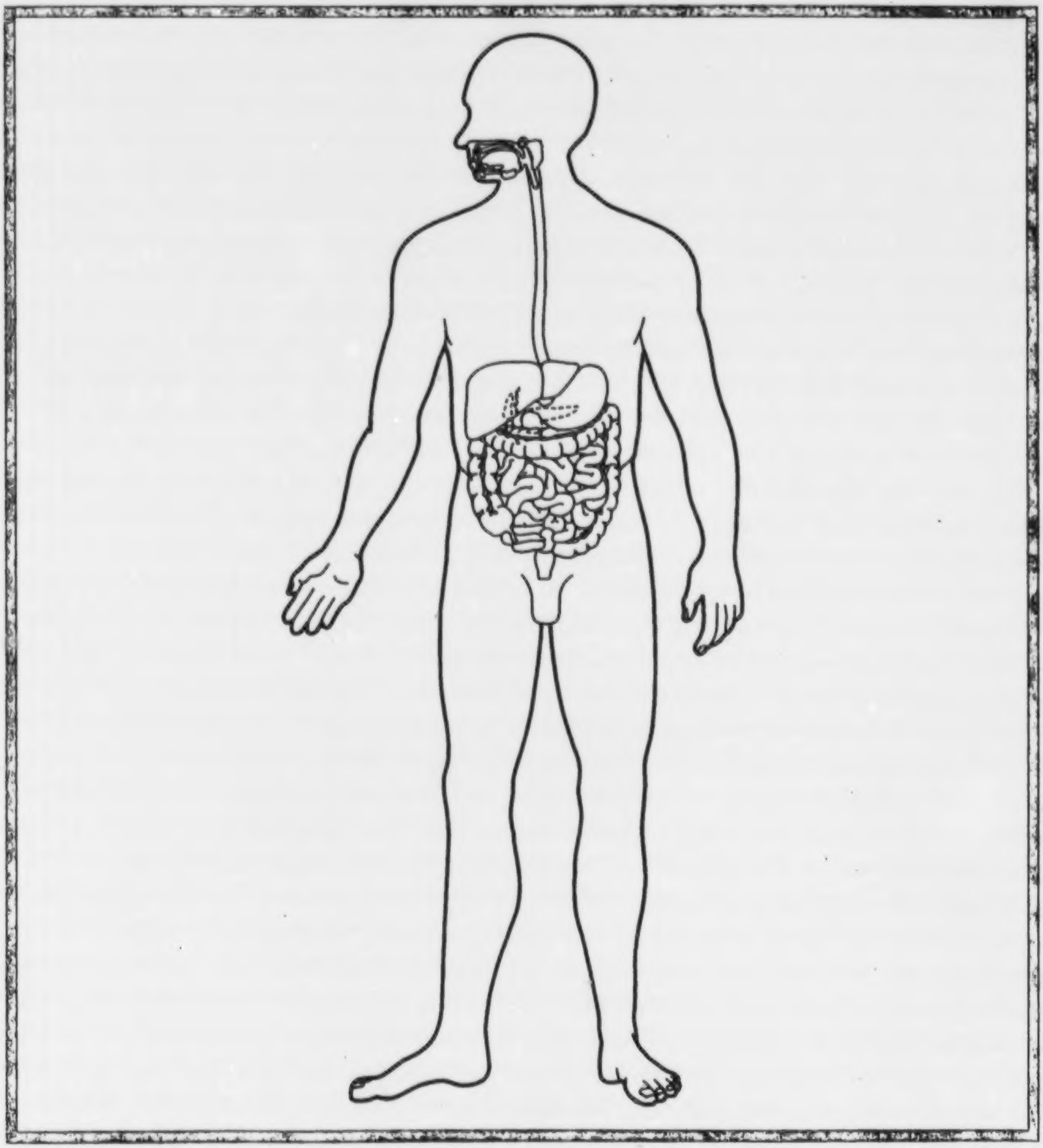
Nervous System



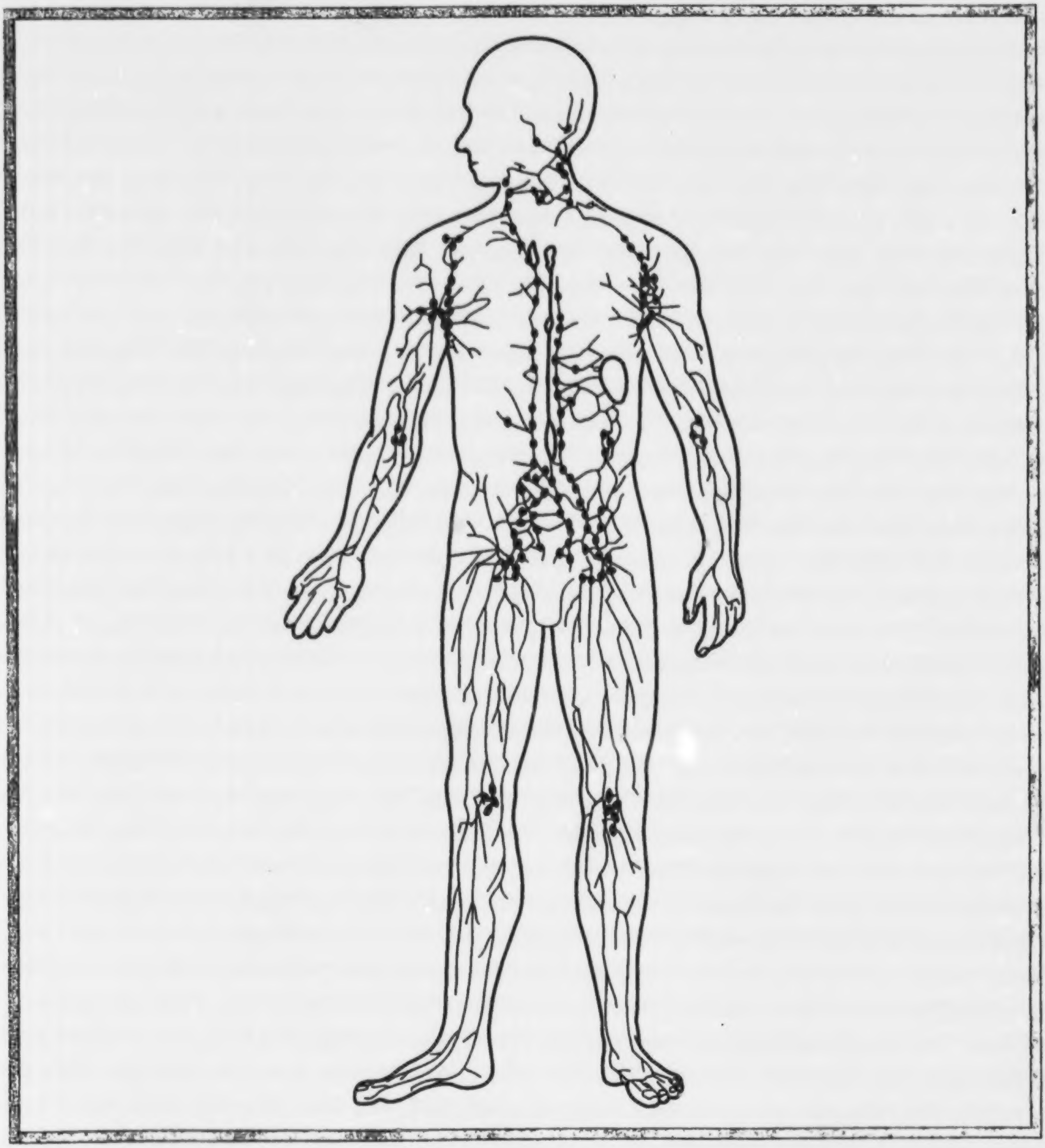
Special Senses



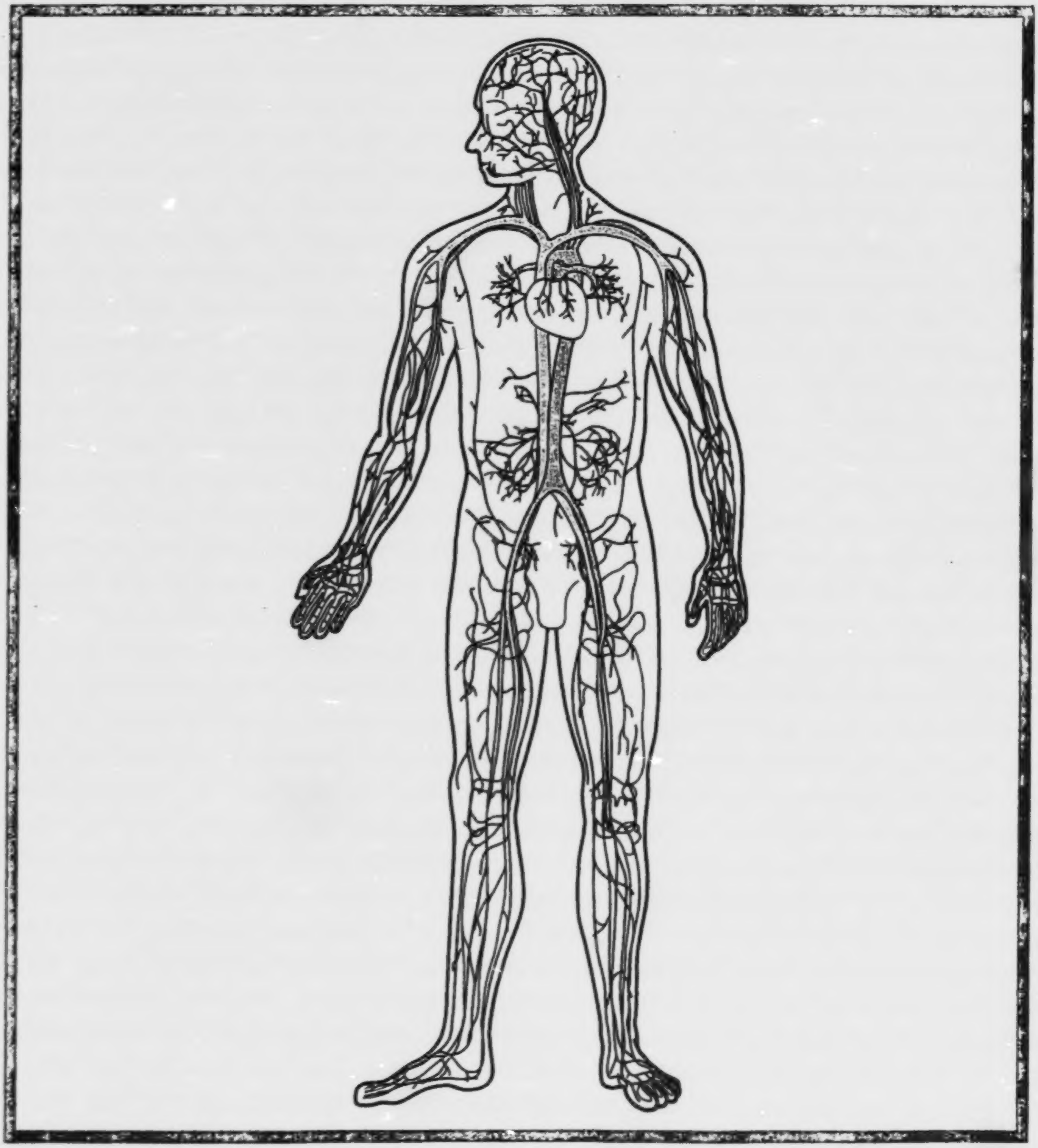
Digestive System



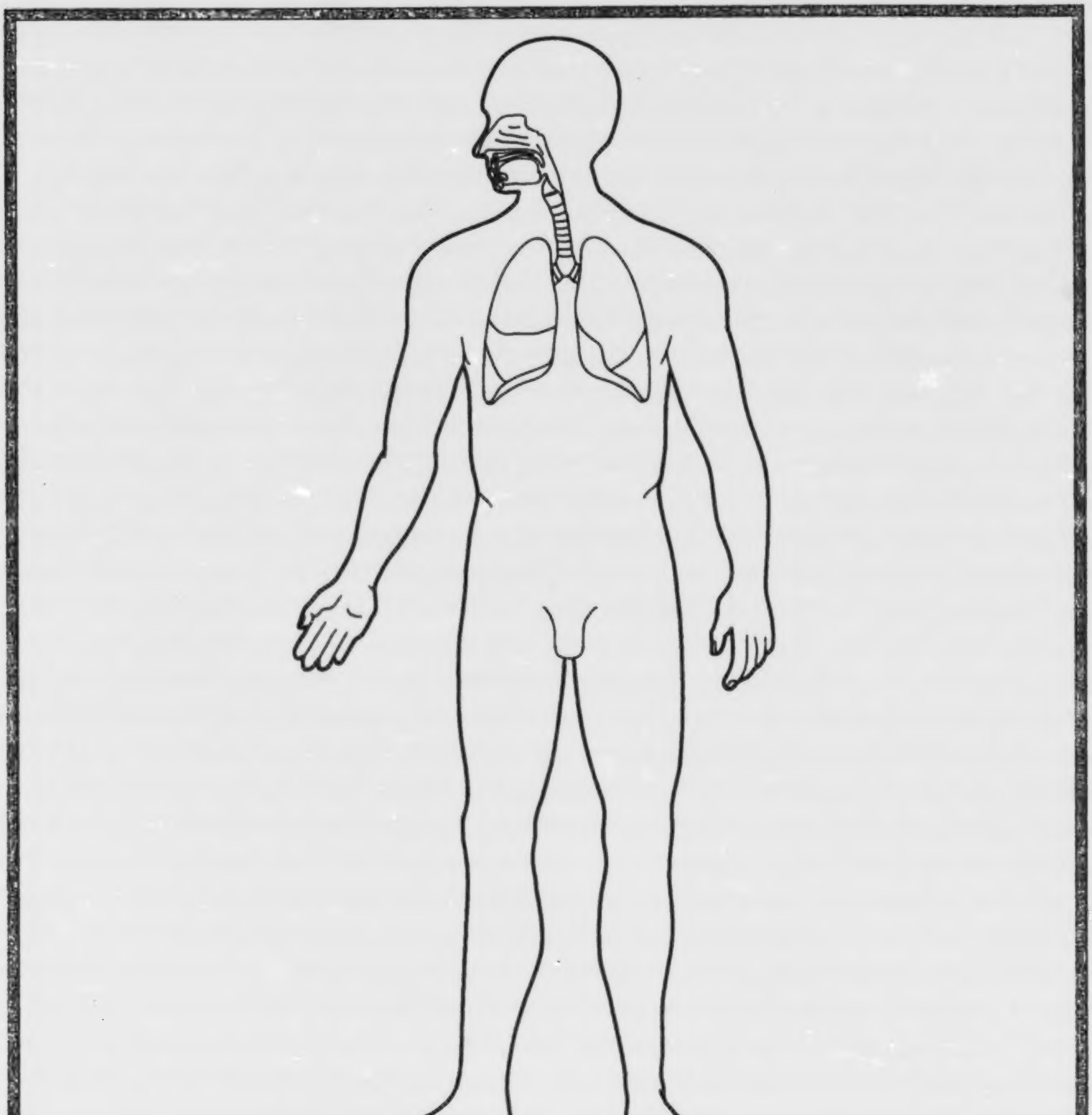
Circulatory System: Lymphatic



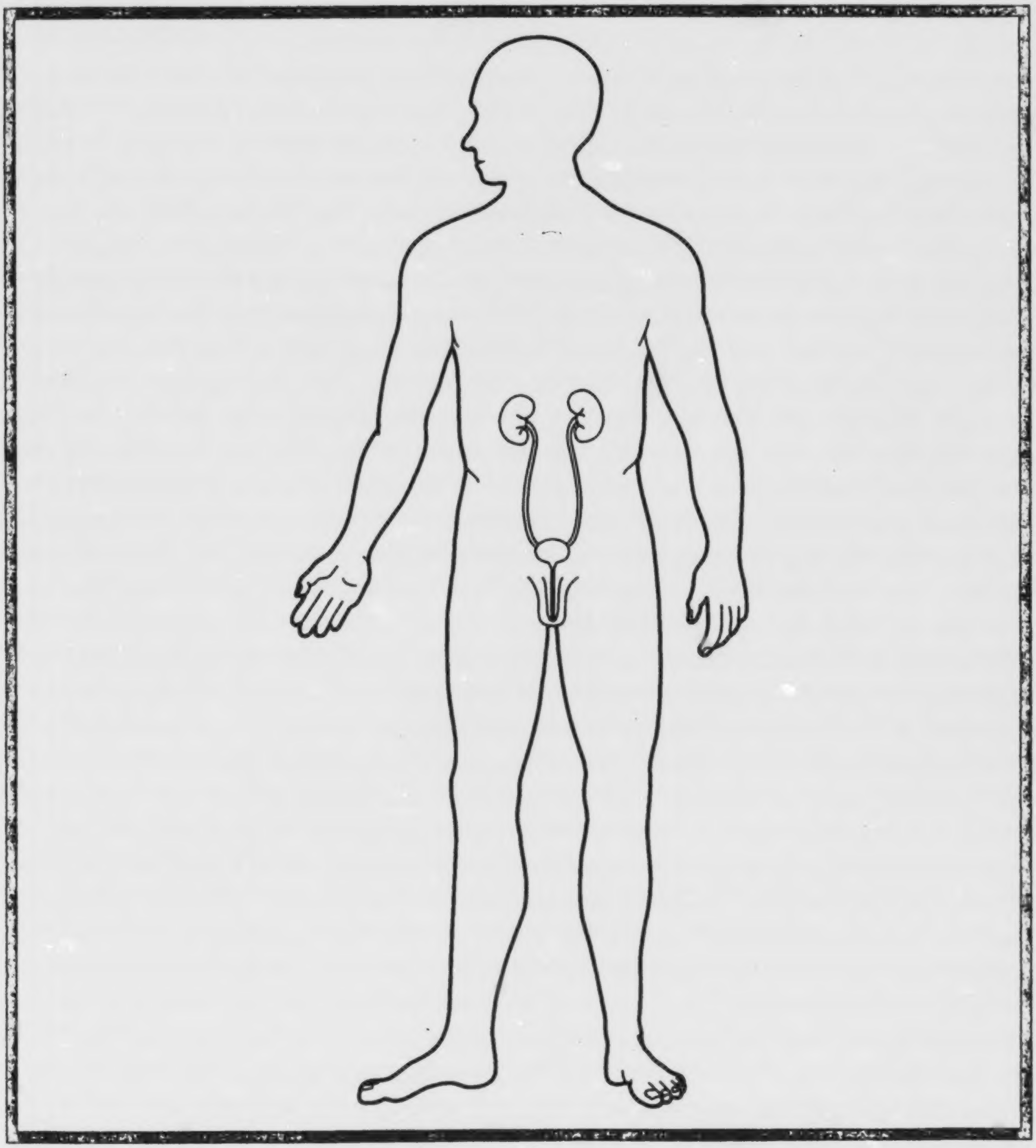
Circulatory System: Blood



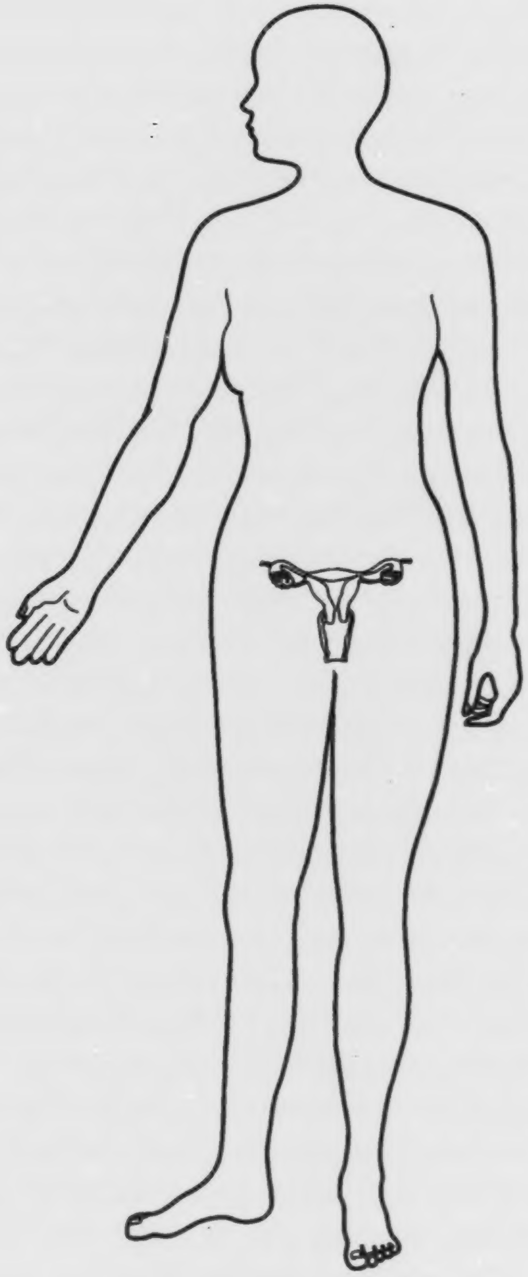
Respiratory System



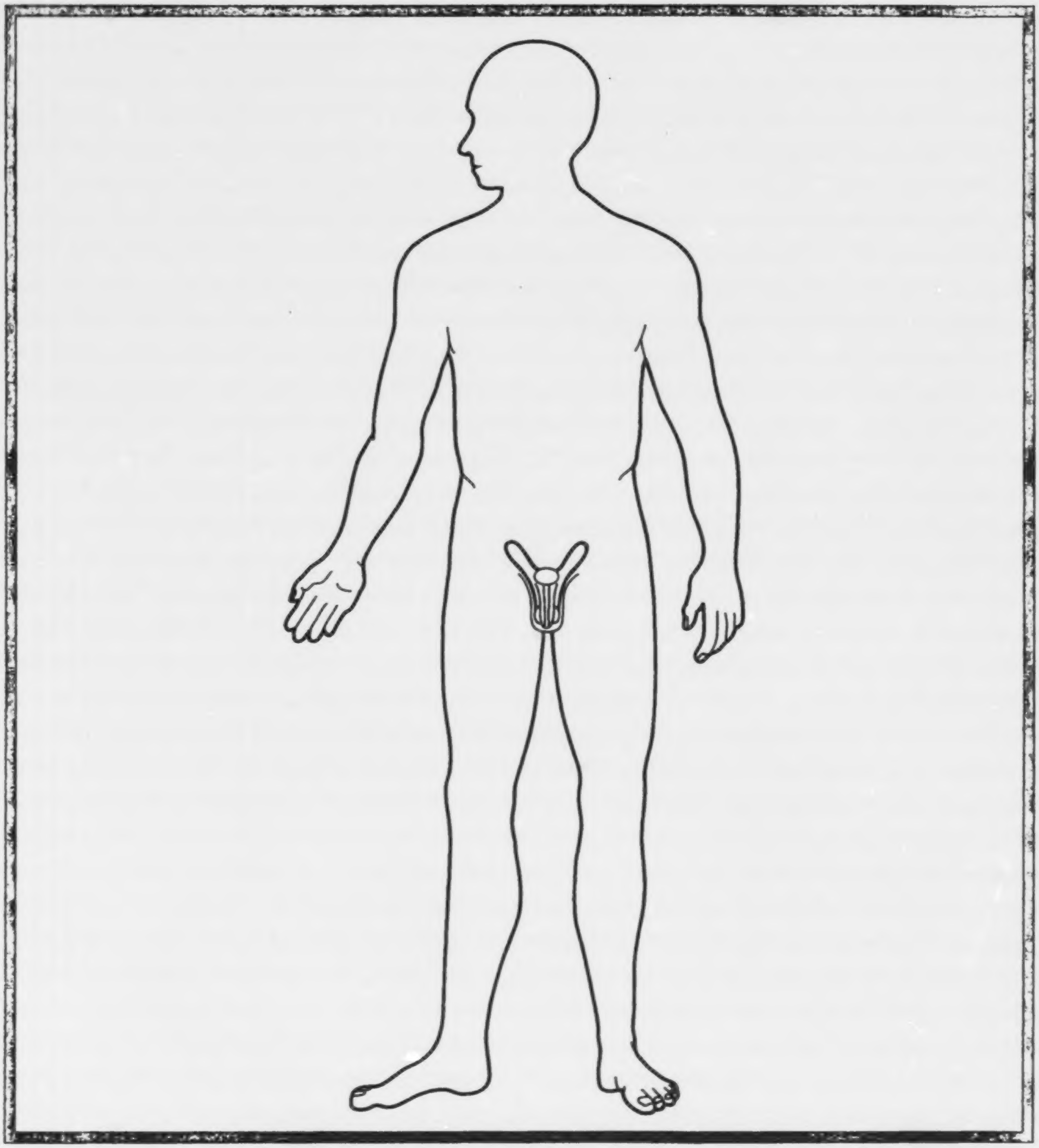
Urinary System



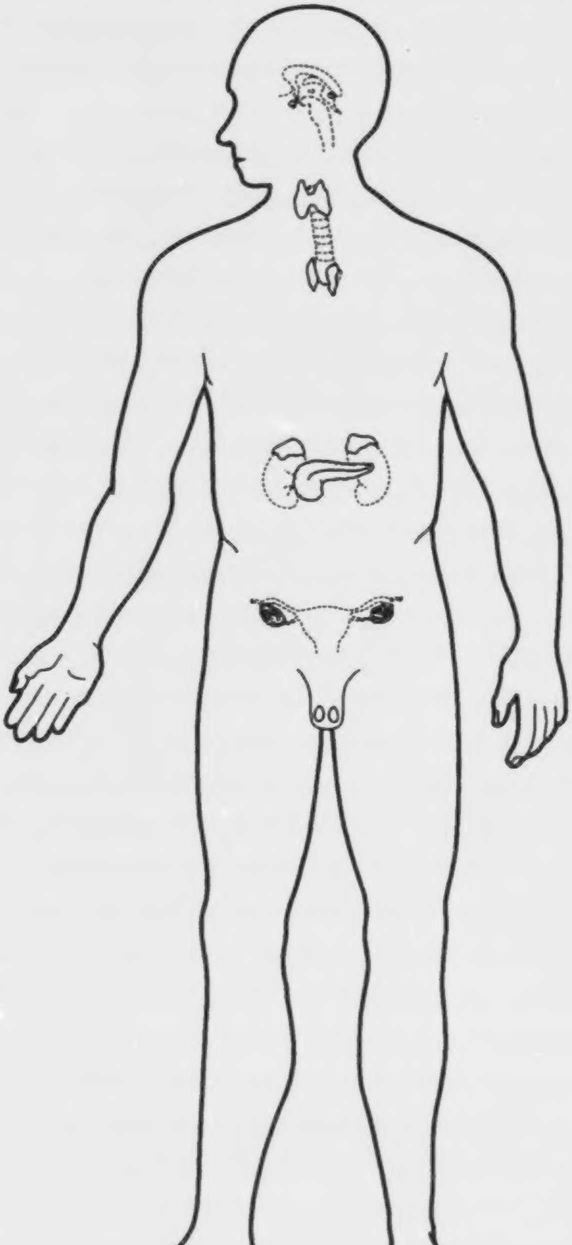
Reproductive System: Female



Reproductive System: Male



Endocrine System



Written Test

Name ______________________________

Date ____________________ Score ____________________

Objective 1 Define the terms *anatomy* and *physiology*. Write your answers on the blank lines provided beside each of the terms below.

a. Anatomy ______________________________

____

b. Physiology ______________________________

____

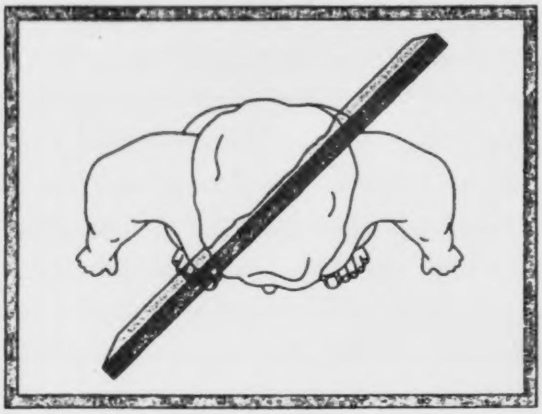
Objective 2 Define the term *anatomical position*. Write your answer on the blank lines provided beside the term below.

Anatomical position ______________________________

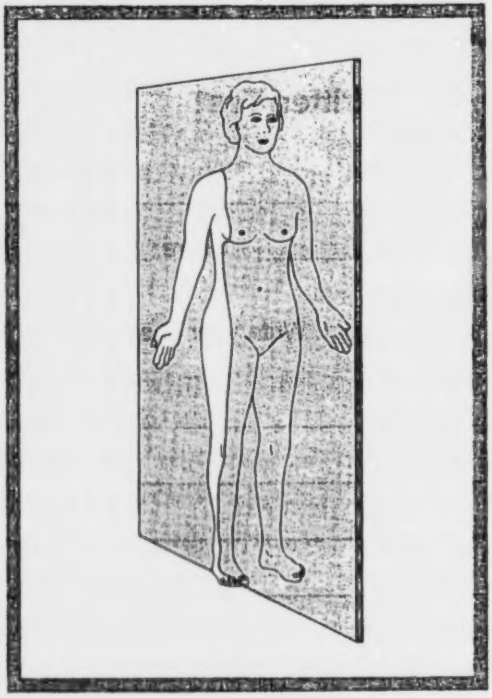
____

____

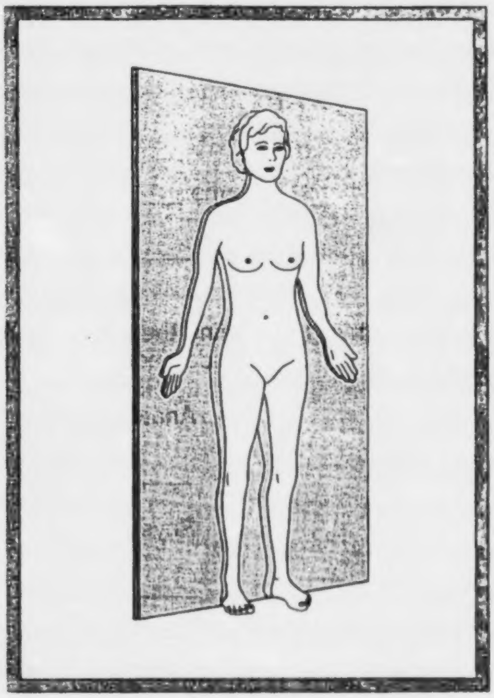
Objective 3 Label the common body planes. Write your answers on the blank lines provided under each of the illustrations below and on the next page.



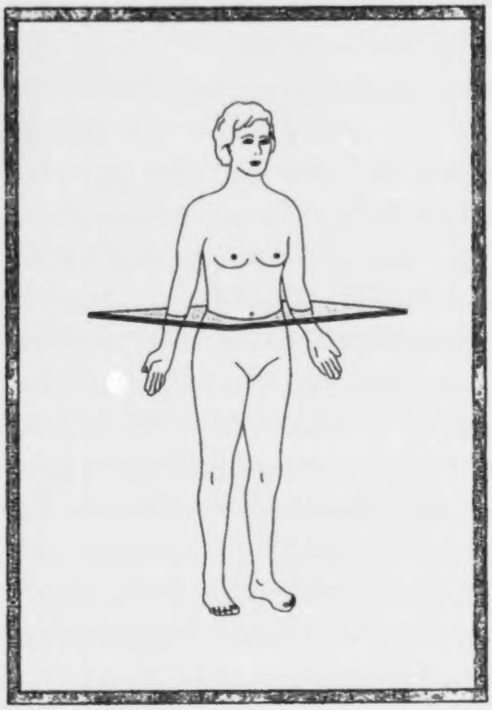
a. ____________________



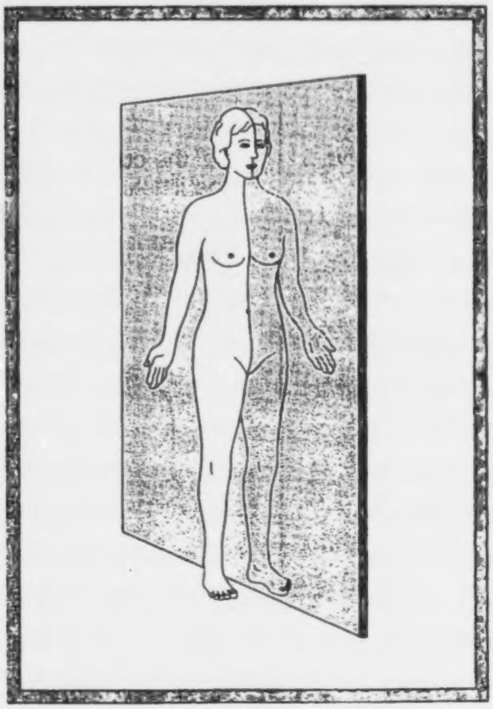
b. ______________________________



c. ______________________________



d. ______________________________



e. ______________________________

OBJECTIVE 4

Match the directional terms used in anatomy to their correct descriptions. Write the numbers on the blanks provided.

_______ a. At the wall of a body cavity
_______ b. Farther from the head
_______ c. Away from the surface
_______ d. Within a body cavity
_______ e. Nearer to a point of reference
_______ f. More toward the front of the body
_______ g. Below the surface
_______ h. Farther from a point of reference
_______ i. More toward the head
_______ j. On the surface
_______ k. More toward the backside of the body
_______ l. Closer to the midline of the body
_______ m. At or near the edge
_______ n. At or near the middle
_______ o. Farther from the midline of the body
_______ p. Near the surface

1. Anterior
2. Central
3. Deep
4. Distal
5. Exterior
6. Inferior
7. Internal
8. Lateral
9. Medial
10. Parietal
11. Peripheral
12. Posterior
13. Proximal
14. Superficial
15. Superior
16. Visceral

OBJECTIVE 5

Describe the locating terms used in anatomy. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Caudal ______________________________

____

b. Cephalic ______________________________

____

c. Greater curvature ______________________________

____

d. Lesser curvature ______________________________

____

e. Palmar ____________________

f. Plantar ____________________

OBJECTIVE 6 Describe the body positions. Write your answers on the blank lines provided beside each of the terms below.

a. Erect ____________________

b. Lateral ____________________

c. Prone ____________________

d. Supine ____________________

OBJECTIVE 7 List the general regions of the body. Write your answers on the blank lines provided below.

a. ____________________

b. ____________________

c. ____________________

OBJECTIVE 8 State the contents of the major body cavities. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Abdominal cavity ____________________

b. Cranial cavity ____________________

c. Mediastinal space ____________________

d. Pelvic cavity ____________________

e. Pericardial cavity ____________________

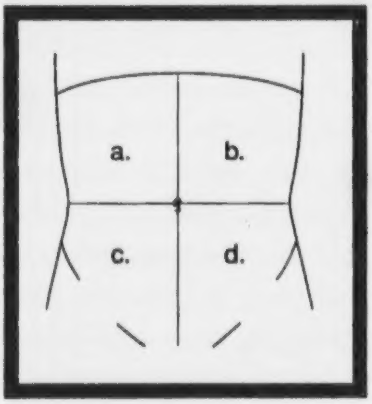
f. Pleural cavities ______________________________

____

g. Spinal cavity ______________________________

____

OBJECTIVE 9 Label the quadrants of the abdominopelvic cavity. Write your answers on the blank lines provided beside the illustration below.



a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

OBJECTIVE 10 Match the major abdominopelvic organs to their correct quadrant locations. Write the numbers on the blanks provided.

______ a. Lower ascending colon, cecum, appendix, lower right ureter, terminal ileum, part of the urinary bladder, sex organs

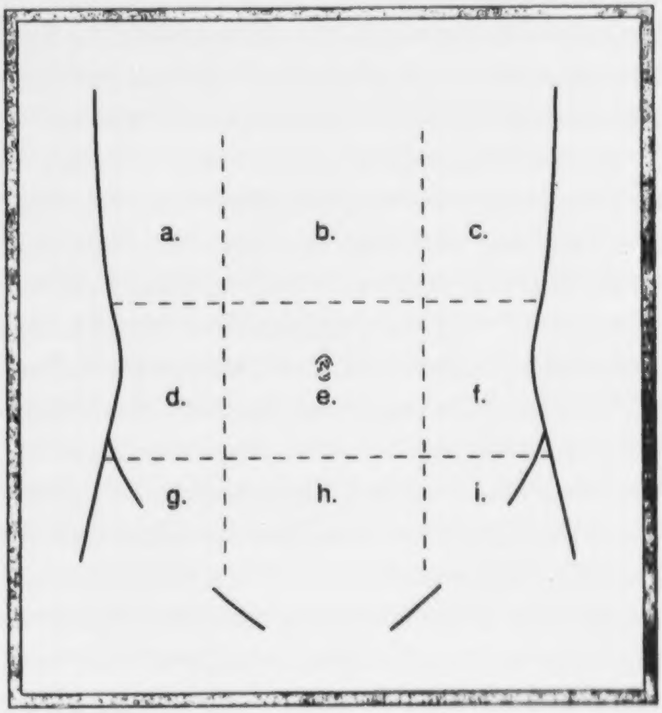
______ b. Ascending part of the duodenum, upper descending colon, left half of the transverse colon, spleen, small part of the liver, left adrenal gland, left kidney, upper part of the left ureter, stomach

______ c. Part of the small intestine, including the descending duodenum; upper ascending colon; most of the liver; gallbladder; bile ducts; head of the pancreas; right adrenal gland; right kidney; upper part of the right ureter

______ d. Lower descending colon, small intestine, part of the urinary bladder, sex organs

1. Right upper quadrant
2. Left upper quadrant
3. Right lower quadrant
4. Left lower quadrant

OBJECTIVE 11 Label the regions of the abdomen. Write your answers on the blank lines provided under the illustration below.



a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

OBJECTIVE 12

List the major body structures in order of increasing complexity. Write your answers on the blank lines provided below.

a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

OBJECTIVE 13

Match the major organ systems to their correct functions. Write the numbers on the blanks provided.

1. Circulatory system
2. Digestive system
3. Endocrine system
4. Immune system
5. Integumentary system
6. Muscular system
7. Nervous system
8. Reproductive system
9. Respiratory system
10. Skeletal system
11. Special senses
12. Urinary system

_______ a. Receives, breaks down, and absorbs food substances and excretes waste products

_______ b. Serves in removing waste products from the blood and in excreting wastes in the form of urine

_______ c. Provides protection against disease and infection

_______ d. Provides the framework for the body and works to protect and support the body

_______ e. Provides for body movement and support

_______ f. Involved with reproduction and childbirth

_______ g. Protects the organism from injury, disease, and infection; aids in the regulation of temperature, the excretion of wastes, and the reception of sensations

_______ h. Takes in oxygen from the air and gives off carbon dioxide, which is produced by cell metabolism

_______ i. Serves to regulate various body functions through glands that secrete hormones directly into the blood to slow down or increase the activity of the cells

_______ j. Coordinates body activities by receiving, interpreting, and conducting messages to all the other systems of the body

_______ k. Transports materials throughout the body by carrying oxygen and nutrients in the blood to all the cells of the body and carrying away the waste products of the cells

_______ l. Function in receiving sensations such as sight, smell, hearing, and taste

OBJECTIVE 14

List the major organs and structures in each of the major organ systems. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Integumentary system ______________________________

b. Skeletal system ______________________________

c. Muscular system ______________________________

d. Nervous system ______________________________

e. Special senses ______________________________

f. Digestive system ______________________________

g. Circulatory system ______________________________

h. Respiratory system ______________________________

i. Urinary system ____________________

j. Reproductive system ____________________

k. Endocrine system ____________________

l. Immune system ____________________

Answers to Written Test

OBJECTIVE 1

a. The scientific study of the structure of an organism that describes the size, shape, construction, and relative positions of the organs in the body

b. The scientific study of the functions of an organism that describes how the organs work independently and in relation to the whole organism

OBJECTIVE 2

A position of the body in which a person stands erect, facing directly forward, feet pointed forward and slightly apart, arms hanging down at the sides with the palms facing forward; a standard method of viewing the body so that the anatomy can be consistently described

OBJECTIVE 3

a. Oblique plane
b. Sagittal plane
c. Coronal plane
d. Transverse plane
e. Median plane

OBJECTIVE 4

a. 10
b. 6
c. 3
d. 16
e. 13
f. 1
g. 7
h. 4
i. 15
j. 5
k. 12
l. 9
m. 11
n. 2
o. 8
p. 14

OBJECTIVE 5

a. Referring to the tail or tail end of a structure
b. Referring to the head or to the head end of a structure
c. Referring to the outer and longer portion of a curved structure
d. Referring to the inner and shorter portion of a curved structure
e. Referring to the palm of the hand
f. Referring to the sole of the foot

OBJECTIVE 6

a. Standing or sitting upright
b. Lying on one side
c. Lying down on the stomach
d. Lying down face up

OBJECTIVE 7

Answers may appear in any order.

a. Head
b. Trunk
c. Limbs

OBJECTIVE 8

a. Stomach, liver, gallbladder, spleen, pancreas, most of the small and large intestines, kidneys

b. Brain and pituitary gland

c. Thymus gland, trachea, esophagus, bronchi, ends of the vena cavae, beginning of the aorta

d. Urinary bladder, sex organs, part of the large intestine, including the cecum, appendix, and rectum

e. Heart

f. One lung in each

g. Spinal cord

OBJECTIVE 9

a. Right upper quadrant
b. Left upper quadrant
c. Right lower quadrant
d. Left lower quadrant

OBJECTIVE 10

a. 3
b. 2
c. 1
d. 4

OBJECTIVE 11

a. Right hypochondriac region
b. Epigastric region
c. Left hypochondriac region
d. Right lumbar region
e. Umbilical region
f. Left lumbar region
g. Right iliac region
h. Hypogastric region
i. Left iliac region

OBJECTIVE 12

a. Cell
b. Tissue
c. Organ
d. Organ system
e. Organism

OBJECTIVE 13

a. 2
b. 12
c. 4
d. 10
e. 6
f. 8
g. 5
h. 9
i. 3
j. 7
k. 1
l. 11

OBJECTIVE 14

a. Skin, hair, nails, duct glands

b. Bones, joints, cartilage, connective tissue

c. Skeletal, smooth, and cardiac muscles

d. Brain, spinal cord, peripheral nerves

e. Eyes, ears, nose, taste buds

f. Mouth, pharynx, esophagus, stomach, large and small intestines, accessory organs such as the gallbladder and pancreas

g. Heart, blood vessels, blood, lymphatic tissues

h. Lungs, nose, pharynx, larynx, trachea

i. Kidneys, ureter, bladder, urethra

j. Sex organs and ducts to the outside

k. Ductless glands

l. White blood cells, antibodies

Answers to Assignment Sheets

Assignment Sheet 1

Suggested answers

PROBLEM 1 Begin the incision 2 cm to the left of the median plane and even with the inferior end of the nose and proceed parallel to the nasolabial groove for 2 cm.

PROBLEM 2 Begin the incision on the medial side of the left knee and proceed anteriorly to the central point of the knee.

PROBLEM 3 Begin the incision 2 cm to the right of the median plane of the back at the intersection of the transverse plane and proceed laterally for 4 cm at an angle so that the lateral end of the incision is approximately 2 cm superior to the medial end of the incision.

PROBLEM 4 Begin the incision on the medial plane of the chest at a point even with the nipples; proceed obliquely to a point approximately 8 cm superior to the left nipple; make a second incision approximately 5 cm long and at a 90-degree angle to the first.

PROBLEM 5 Begin the incision at a point even with and approximately 2 cm inferior to the medial end of the right eye; proceed with the incision obliquely lateral so that the end of the incision is proximal to the inferior end of the ear lobe.

Assignment Sheet 2

PROBLEM 1

a. An inflammation of an organ
b. Of or related to the kidneys
c. An inflammation of the kidney

PROBLEM 2

a. Against or opposing
b. Pertaining to or characterized by fever
c. Aspirin reduces fever.

PROBLEM 3

a. A specified action, process, or result; an increase in a pathologic condition
b. Pertaining to an artery
c. Hard
d. Deterioration and loss of elasticity of the arteries

Problem 4

a. Presence of a substance in the urine
b. Pertaining to any bacterial microorganism
c. Excessive bacteria in the urine

Problem 5

a. Swelling resulting from an excessive accumulation of serous fluid in the tissues of the body in specified locations

b. Pertaining to the head

c. Swelling of the head

Problem 6

Cardiologist—from the root word *cardio*, meaning 'pertaining to the heart'; from the suffix *-logy*, meaning 'a science or study of'; and from the suffix *-ist*, meaning a 'practitioner of a science'

Problem 7

An artificial opening for the colon, derived from *colo-* for colon and *stoma-* for a hole or opening

Problem 8

Thyroidectomy

Problem 9

An image of blood vessels

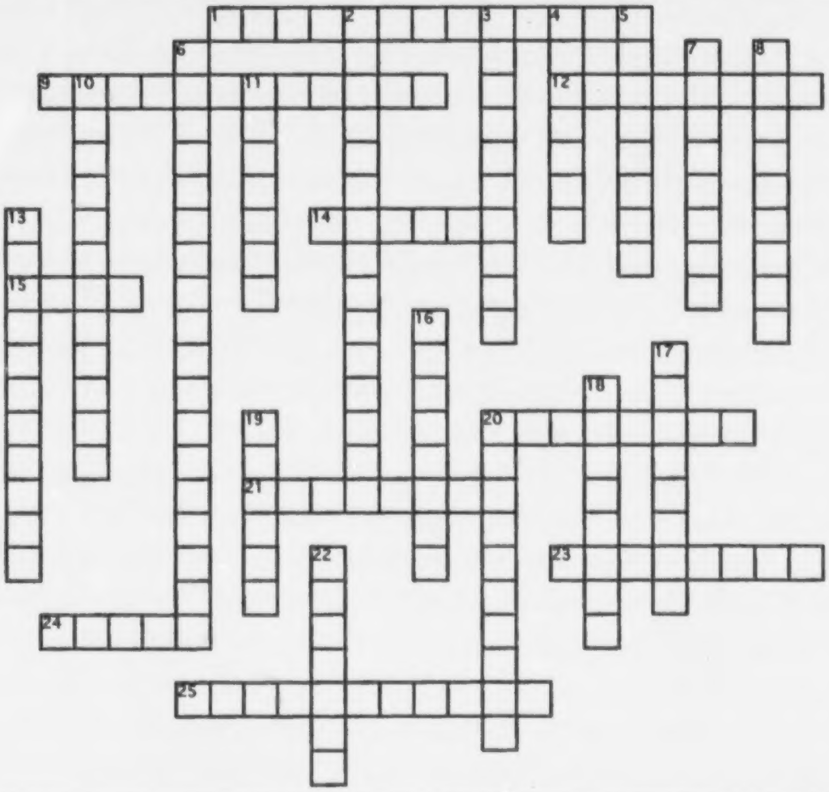
Problem 10

The term for normal breathing is *eupnea*, and the term for difficult breathing is *dyspena*. Eupnea comes from the prefix *eu-*, meaning well or easily, and from the root word *pnea*, meaning breath or breathing. Dyspena comes from the prefix *dys-*, meaning bad, painful, or disordered, and from the root word *pnea*, meaning breath or breathing.

Module Set I: Introduction to Anatomy and Physiology
Module 1: Organization of the Human Body

Crossword Puzzle 1—Terms from Objectives 1 Through 4

Name ______________________________ Date ______________



ACROSS

1. A lengthwise plane running parallel to the median plane but not through the midline and dividing the body into unequal left and right parts (2 words)
9. A lengthwise plane running from side to side and dividing the body into front and back parts (2 words)
12. More toward the front of the body
14. Closer to the midline of the body
15. Away from the surface
20. At the wall of a body cavity
21. More toward the head
23. A living person, animal, or plant
24. A special structure within the body that is arranged in an organized manner to perform a specific function
25. Near the surface

DOWN

2. A horizontal plane passing through the body from front to back and dividing the body into equal upper and lower parts (2 words)
3. The scientific study of the functions of an organism that describes how the organs work independently and in relation to the whole organism
4. The scientific study of the structure of an organism that describes the size, shape, construction, and relative positions of the organs in the body
5. On the surface
6. A position of the body in which a person stands erect, facing directly forward, feet pointed forward and slightly apart, arms hanging down at the sides with the palms facing forward; a standard method of viewing the body so that the anatomy can be consistently described (2 words)
7. Nearer to a point of reference
8. More toward the backside of the body
10. A lengthwise plane passing through the body at a 45-degree angle to a sagittal plane or to the median plane (2 words)
11. Farther from the midline of the body
13. A lengthwise plane running through the midline of the body from front to back and dividing the body into equal right and left halves (2 words)
16. Farther from the head
17. Below the surface
18. Within a body cavity
19. Farther from a point of reference
20. At or near the edge
22. At or near the middle

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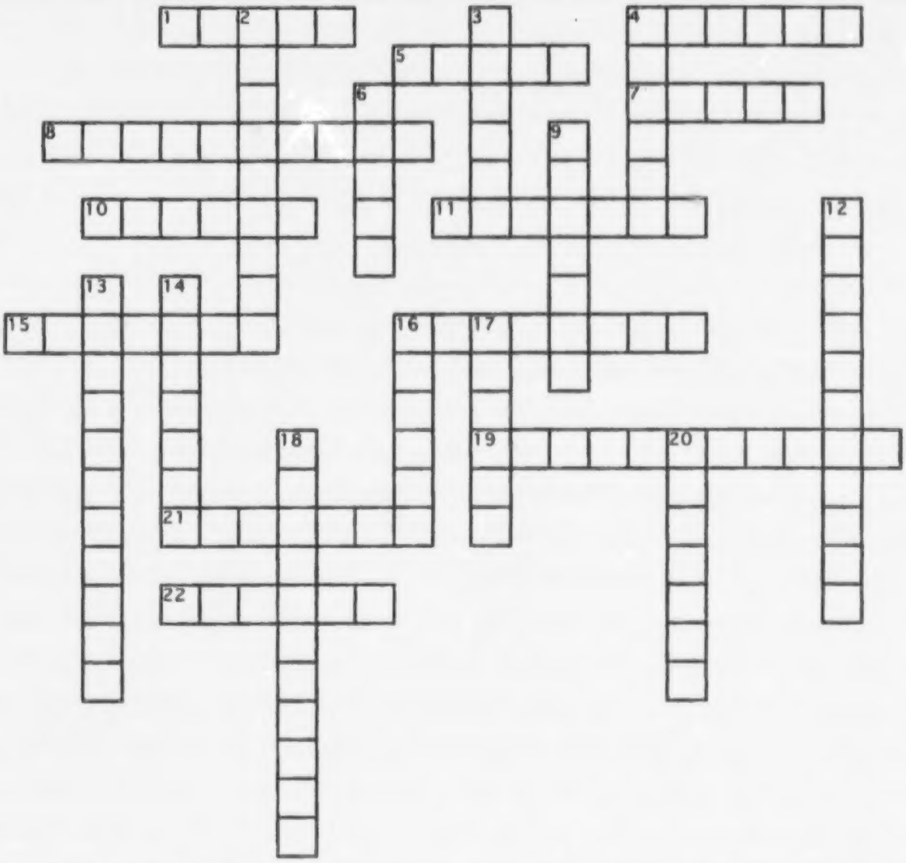
Crossword Puzzle 2—Terms from Objectives 5 Through 8

Name ______________________________ Date ______________



ACROSS

1. Any of various structures within the body that produce specific chemicals to help with the functions of the body
4. Cavity containing the spinal cord
5. Standing or sitting upright
7. Lying down on the stomach
8. An organ that must function properly in order for the life of the organism to continue (2 words)
10. Cavity containing the urinary bladder, sex organs, part of the large intestine, including the cecum, appendix, and rectum
11. Curvature/referring to the outer and longer portion of a curved structure
15. Cavities containing one lung in each
16. Referring to the head or to the head end of a structure
19. Space containing the thymus gland, trachea, esophagus, bronchi, ends of the vena cavae, beginning of the aorta
21. Lying on one side
22. A group of organs and related structures that work together to perform a common function

DOWN

2. Cavity containing the stomach, liver, gallbladder, spleen, pancreas, most of the small and large intestines, kidneys
3. Curvature/referring to the inner and shorter portion of a curved structure
4. Lying down face up
6. Resulting in death
9. Referring to the sole of the foot
12. An evaluation of a person's health based on appearance, the person's feelings and behavior, and the status of indicators of health such as temperature, blood pressure, and body chemistry
13. Cavity containing the heart
14. Cavity containing the brain and pituitary gland
16. Referring to the tail or tail end of a structure
17. Referring to the palm of the hand
18. To create in a patient a loss of sensation, with or without a loss of consciousness; to create a condition of anesthesia in a patient; to administer an anesthetic
20. A medical procedure intended to correct physical defects, repair injuries, or treat diseases, especially through the use of medical instruments

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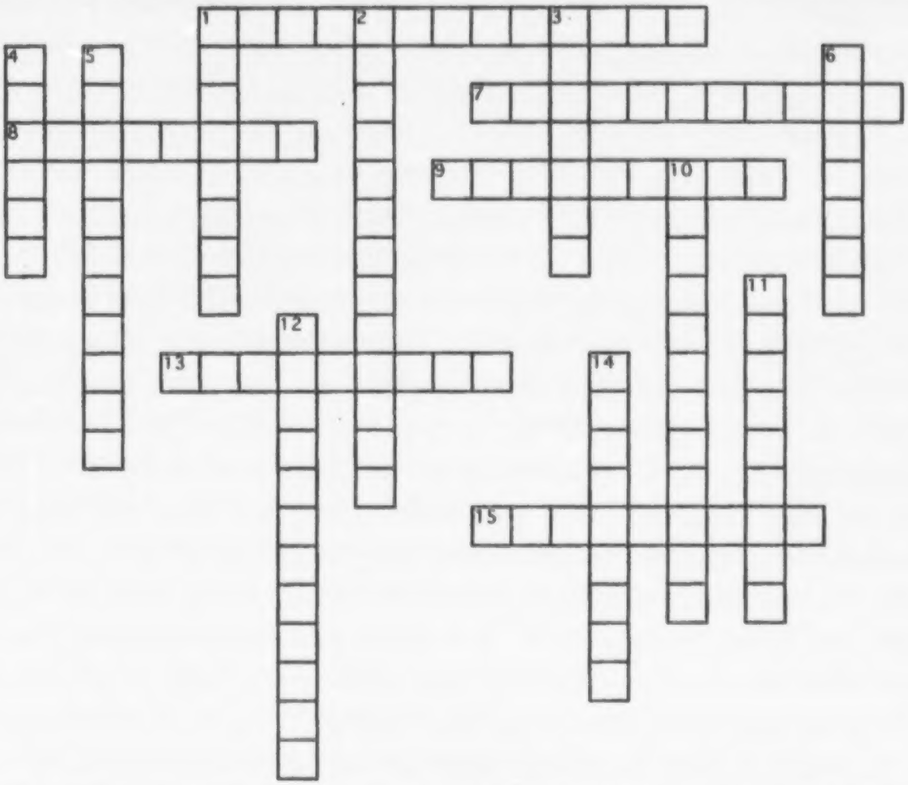
Crossword Puzzle 3—Terms from Objectives 9 Through 13

Name ______________________________ Date ____________



ACROSS

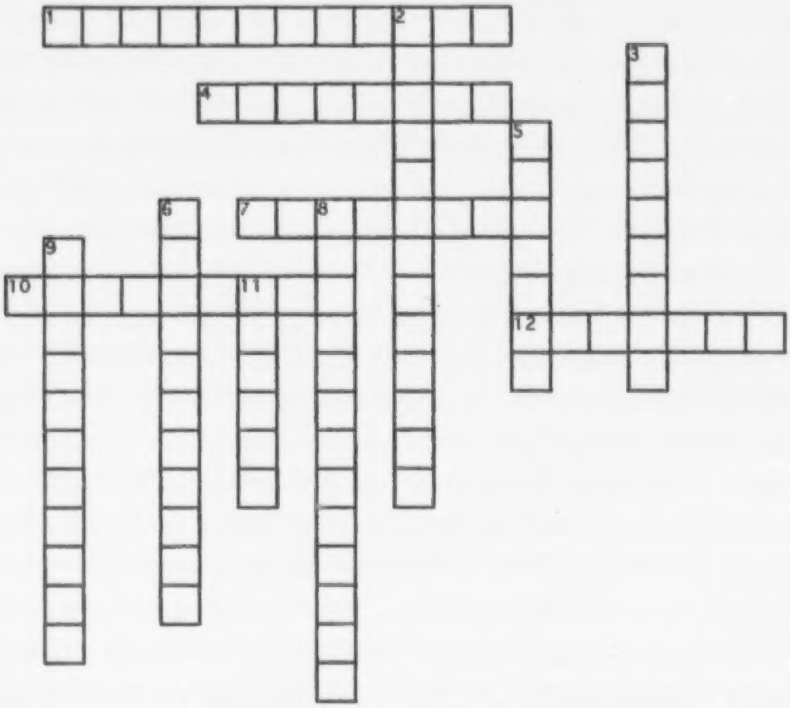
1. Systems that function in receiving sensations such as sight, smell, hearing, and taste (2 words)
7. System that transports materials throughout the body by carrying oxygen and nutrients in the blood to all the cells of the body and carrying away the waste products of the cells
8. System that provides for body movement and support
9. System that serves to regulate various body functions through glands that secrete hormones directly into the blood to slow down or increase the activity of the cells
13. System that receives, breaks down, and absorbs food substances and excretes waste products
15. The point at which the umbilical cord joined the fetus to the mother's womb during pregnancy; commonly referred to as the *navel* or *belly button*

DOWN

1. System that provides the framework for the body and works to protect and support the body
2. System that protects the organism from injury, disease, and infection; aids in the regulation of temperature, the excretion of wastes, and the reception of sensations
3. System that coordinates body activities by receiving, interpreting, and conducting messages to all the other systems of the body
4. System that provides protection against disease and infection
5. System that takes in oxygen from the air and gives off carbon dioxide, which is produced by cell metabolism
6. System that serves in removing waste products from the blood and in excreting wastes in the form of urine
10. A group of reactions exhibited by tissue when exposed to irritants; the reactions may include swelling, heat, pain, and other signs of irritation
11. A part of the body, such as the heart, a bone, a gland, a cell, or a limb
12. System that is involved with reproduction and childbirth
14. A type of body tissue that forms the skeleton of the developing fetus, most of which is converted to bone after birth

Crossword Puzzle 4—Terms from Objective 14

Name ______________________________ Date ______________



ACROSS

System that contains . . .

1. Sex organs and ducts to the outside
4. Bones, joints, cartilage, connective tissue
7. Skeletal, smooth, and cardiac muscles
10. Mouth, pharynx, esophagus, stomach, large and small intestines, accessory organs such as the gallbladder and pancreas
12. Kidneys, ureter, bladder, urethra

DOWN

System that contains . . .

2. Skin, hair, nails, duct glands
3. Ductless glands
5. Brain, spinal cord, peripheral nerves
6. Lungs, nose, pharynx, larynx, trachea
8. Eyes, ears, nose, taste buds (2 words)
9. Heart, blood vessels, blood, lymphatic tissues
11. White blood cells, antibodies

Answers to Crossword Puzzles

Crossword Puzzle 1

ACROSS
1. SAGITTAL PLANE
9. CORONAL PLANE
12. ANTERIOR
14. MEDIAL
15. DEEP
20. PARIETAL
21. SUPERIOR
23. ORGANISM
24. ORGAN
25. SUPERFICIAL

DOWN
2. TRANSVERSE PLANE
3. PHYSIOLOGY
4. ANATOMY
5. EXTERIOR
6. ANATOMICAL POSITION
7. PROXIMAL
8. POSTERIOR
10. OBLIQUE PLANE
11. LATERAL
13. MEDIAN PLANE
16. INFERIOR
17. INTERNAL
18. VISCERAL
19. DISTAL
20. PERIPHERAL
22. CENTRAL

Crossword Puzzle 2

ACROSS
1. GLAND
4. SPINAL
5. ERECT
7. PRONE
8. VITAL ORGAN
10. PELVIC
11. GREATER
15. PLEURAL
16. CEPHALIC
19. MEDIASTINAL
21. LATERAL
22. SYSTEM

DOWN
2. ABDOMINAL
3. LESSER
4. SUPINE
6. FATAL
9. PLANTAR
12. EXAMINATION
13. PERICARDIAL
14. CRANIAL
16. CAUDAL
17. PALMAR
18. ANESTHETIZE
20. SURGERY

Crossword Puzzle 3

ACROSS		DOWN	
1.	SPECIAL SENSES	1.	SKELETAL
7.	CIRCULATORY	2.	INTEGUMENTARY
8.	MUSCULAR	3.	NERVOUS
9.	ENDOCRINE	4.	IMMUNE
13.	DIGESTIVE	5.	RESPIRATORY
15.	UMBILICUS	6.	URINARY
		10.	INFLAMMATION
		11.	STRUCTURE
		12.	REPRODUCTIVE
		14.	CARTILAGE

Crossword Puzzle 4

ACROSS		DOWN	
1.	REPRODUCTIVE	2.	INTEGUMENTARY
4.	SKELETAL	3.	ENDOCRINE
7.	MUSCULAR	5.	NERVOUS
10.	DIGESTIVE	6.	RESPIRATORY
12.	URINARY	8.	SPECIAL SENSES
		9.	CIRCULATORY
		11.	IMMUNE

Module Review

Name ______________________________

Date ____________________ Score ____________________

DIRECTIONS Read each of the items below. From the choices given, select the response that most-correctly provides the required information. Circle the letter of the most-correct response.

Objective 6

1. A person sitting or standing upright is in what body position?
   a. erect
   b. supine
   c. prone
   d. lateral

Objective 10

2. Which of the following organs is NOT located in the right upper quadrant of the abdominopelvic cavity?
   a. gallbladder
   b. left kidney
   c. bile ducts
   d. most of the liver

Objective 13

3. Which of the following is NOT a function of the digestive system?
   a. receives food substances
   b. breaks down and absorbs food substances
   c. circulates digested nutrients to other parts of the body
   d. excretes waste products

Objective 14

4. The skin, hair, nails, and duct glands are part of what organ system?
   a. endocrine system
   b. special sense system
   c. specialized sensation system
   d. integumentary system

Objective 14

5. The reproductive system includes which of the following?

   a. sex organs and ducts to the outside

   b. sex organs and the alimentary canal

   c. ducted and ductless glands

   d. glands and the urinary system

Objective 8

6. In what body cavity is the liver located?

   a. pleural cavity

   b. pericardial cavity

   c. peritoneal cavity

   d. abdominal cavity

Objective 4

7. What term is used for a structure near the middle of a region?

   a. central

   b. peripheral

   c. superficial

   d. circumficial

Objective 1

8. Physiology is the scientific study of the ______ of an organism.

   a. functions

   b. structure

   c. purpose

   d. offspring

Objective 3

9. The ______ plane is a horizontal plane passing through the body from front to back and dividing the body into equal upper and lower parts.

   a. coronal

   b. median

   c. sagittal

   d. transverse

Objective 4

10. A ______ structure is one that lies within a body cavity.

    a. visceral

    b. parietal

    c. central

    d. peripheral

Objective 6

11. A person lying down on the stomach is in what body position?

    a. erect

    b. supine

    c. prone

    d. lateral

Objective 7

12. Which of the following is NOT one of the general regions of the body?

    a. head

    b. trunk

    c. limbs

    d. external peripherals

Objective 9

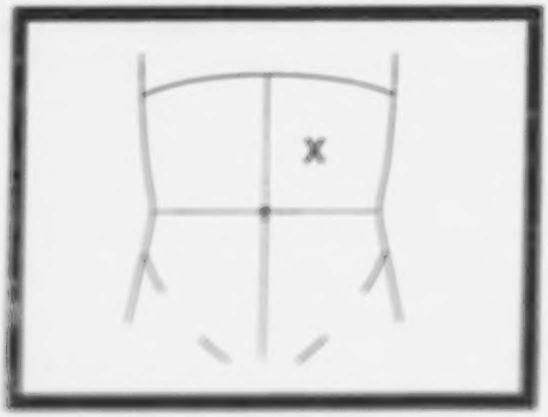
13. In the illustration below, the quadrant marked with an "X" is which quadrant of the abdominopelvic cavity?

    a. right upper

    b. left upper

    c. right lower

    d. left lower



Objective 10

14. Which of the following organs is NOT located in the right lower quadrant of the abdominopelvic cavity?

    a. lower descending colon

    b. lower right ureter

    c. terminal ileum

    d. cecum

Objective 13

15. Which of the organ systems protects the organism from injury, disease, and infection and aids in the regulation of temperature, the excretion of wastes, and the reception of sensations?

    a. endocrine system

    b. immune system

    c. urinary system

    d. integumentary system

Objective 13

16. Which of the following is NOT an activity of the nervous system?

    a. receives messages

    b. receives sensations

    c. interprets messages

    d. conducts messages

Objective 14

17. The kidneys, ureter, bladder, and urethra are part of which organ system?

    a. urinary system

    b. reproductive system

    c. digestive system

    d. endocrine system

Objective 4

18. Using the trunk as a reference point, which of these statements is true?

    a. The knee is more distal than the foot.

    b. The knee is more proximal than the foot.

    c. The knee is more medial than the foot.

    d. The knee is more lateral than the foot.

Objective 4

19. What would be the best term to describe a wound that breaks the skin but does not enter into the muscle tissue?

    a. external

    b. superficial

    c. distal

    d. peripheral

Objective 1

20. Anatomy is the scientific study of the ______ of an organism.

    a. functions

    b. structure

    c. purpose

    d. offspring

Objective 3

21. The ______ plane is a lengthwise plane passing through the body at a 45-degree angle to a sagittal plane or to the median plane.

    a. midline

    b. frontal

    c. horizontal

    d. oblique

Objective 4

22. Using the midline of the head as a reference point, which of the following statements is correct?

    a. The ears are more distal than the nose.

    b. The ears are more lateral than the nose.

    c. Both a and b

    d. Neither a nor b

Objective 6

23. A person lying on either the right or left side is in what body position?

    a. erect

    b. supine

    c. prone

    d. lateral

Objective 8

24. Which of the following is NOT a correct statement?

    a. The pituitary is in the cranial cavity.

    b. The lungs are in the pleural cavities.

    c. The thymus gland, trachea, esophagus, and bronchi are in the mediastinal space.

    d. The urinary bladder, sex organs, cecum, appendix, and rectum are in the abdominal cavity.

Objective 10

25. Which of the following organs is NOT located in the left lower quadrant of the abdominopelvic cavity?

    a. part of the gallbladder

    b. small intestine

    c. lower descending colon

    d. sex organs

Objective 13

26. Which of the major organ systems provides for body movement and support?

    a. skeletal system

    b. muscular system

    c. integumentary system

    d. reproductive system

Objective 13

27. Which organ system serves to regulate various body functions through glands that secrete hormones directly into the blood to slow down or increase the activity of the cells?

    a. endocrine system

    b. gland system

    c. secretion system

    d. hormone system

Objective 14

28. Which of the following is NOT part of the skeletal system?

    a. joints

    b. cartilage

    c. skeletal muscles

    d. connective tissue

Objective 14

29. What type of glands are found in the endocrine system?

    a. salivar
    b. ducted
    c. ductless
    d. sabaceous

Objective 4

30. Which of the following is NOT considered an anterior structure?

    a. nose
    b. chest
    c. back
    d. toe

Objective 2

31. Anatomical position is a position of the body in which a person ______, facing directly forward, feet pointed forward and slightly apart, arms hanging down at the sides with the palms facing ______.

    a. stands erect, outward
    b. stands erect, forward
    c. is supine, outward
    d. is supine, forward

Objective 3

32. The ______ plane is a lengthwise plane running parallel to the median plane but not through the midline and dividing the body into unequal left and right parts.

    a. coronal
    b. median
    c. sagittal
    d. transverse

Objective 4

33. Most organs of the body can be described as ______.

    a. internal
    b. external
    c. superficial
    d. peripheral

Objective 6

34. A person lying on the back facing up is in what body position?
    a. erect
    b. supine
    c. prone
    d. lateral

Objective 8

35. The pericardial cavity contains the ______.
    a. heart
    b. lungs
    c. brain
    d. stomach

Objective 10

36. Which of the following organs is NOT located in the left upper quadrant of the abdominopelvic cavity?
    a. spleen
    b. stomach
    c. upper ascending colon
    d. left half of the transverse colon

Objective 13

37. What is the term for the organ system that functions in receiving special sensations such as sight, smell, hearing, and taste?
    a. special sensations system
    b. special senses system
    c. circulatory system
    d. specialized nervous system

Objective 13

38. Which of the following phrases best describes the function of the respiratory system?

a. takes in oxygen from the air and gives off carbon dioxide, which is produced by cell metabolism

b. takes in carbon dioxide from the air and gives off oxygen that is produced by cell metabolism

c. transports materials throughout the body by carrying oxygen and nutrients in the blood to all the cells of the body and carrying away the waste products of the cells

d. transports materials throughout the body by carrying carbon dioxide and nutrients in the blood to all the cells of the body and carrying away the waste products of the cells

Objective 14

39. Which of the following is NOT part of the respiratory system?

a. nose

b. pharynx

c. trachea

d. esophagus

Objective 14

40. Which of the following is NOT an organ or structure in the muscular system?

a. smooth muscles

b. cardiac muscles

c. skeletal muscles

d. digestive muscles

Objective 3

41. The ______ plane is a lengthwise plane running through the midline of the body from front to back and dividing the body into equal right and left halves.

a. coronal

b. median

c. sagittal

d. transverse

Objective 4

42. A body part that is more toward the head is said to be ______.

    a. superior
    b. inferior
    c. anterior
    d. posterior

Objective 5

43. The term *greater curvature* refers to the ______.

    a. point of the shoulder
    b. protrusion of the hip
    c. shape of the spine
    d. longer portion of a curved organ

Objective 8

44. The ends of the vena cavae and the beginning of the aorta are contained in the ______.

    a. spinal cavity
    b. pericardial cavity
    c. mediastinal space
    d. cranial cavity

Objective 11

45. Which of the following statements is true with regard to the nine abdominal regions?

    a. The epigastric region is superior to the umbilical region.
    b. The left iliac region is superior to the left lumbar region.
    c. The right iliac region is superior to the right hypochondriac region.
    d. The hypogastric region is lateral to the left hypochondriac region.

Objective 14

46. The heart, blood vessels, blood, and lymphatic tissues are part of which organ system?

    a. reproductive system
    b. circulatory system
    c. integumentary system
    d. muscular system

Objective 5

47. On what part of the body would a plantar wart be located?

    a. the nose

    b. the back of the hand

    c. the palm of the hand

    d. the sole of the foot

Objective 3

48. The ______ plane is a lengthwise plane running from side to side and dividing the body into front and back parts.

    a. coronal

    b. median

    c. sagittal

    d. transverse

Objective 5

49. ______ refers to the tail or tail end of a structure.

    a. Cephalic

    b. Caudal

    c. Palmar

    d. Plantar

Objective 12

50. Which of the following is the correct sequence of body structures from simplest to most complex?

    a. cell, tissue, organ, organ system, organism

    b. tissue, cell, organ, organ system, organism

    c. cell, organ, organ system, tissue, organism

    d. cell, tissue, organ system, organ, organism

Module Set I: Introduction to Anatomy and Physiology
Module 1: Organization of the Human Body

Answers to Module Review

1. a
2. b
3. c
4. d
5. a
6. d
7. a
8. a
9. d
10. a
11. c
12. d
13. b
14. a
15. d
16. b
17. a
18. b
19. b
20. b
21. d
22. c
23. d
24. d
25. a
26. b
27. a
28. c
29. c
30. c
31. b
32. c
33. a
34. b
35. a
36. c
37. b
38. a
39. d
40. d
41. b
42. a
43. d
44. c
45. a
46. b
47. d
48. a
49. b
50. a

MODULE SET I: Introduction to Anatomy and Physiology

Module 2: Biochemistry and Microbiology

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Suggested Activities

INSTRUCTIONAL PLAN

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

PREPARATION

- Read the module in the student edition.
- Review the Teaching Suggestions section that follows on page 4 of the Suggested Activities.
- Review the Resources Used in Developing This Module section that follows on page 6 of the Suggested Activities.
- Review the Suggested Web Sites section that follows on page 6 of the Suggested Activities.
- Review the additional resources that follow: transparency masters, Written Test, optional assignment sheet, crossword puzzles, and Module Review.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Make transparencies from the transparency masters.
- Select web sites to be inserted on the Learning Activities Sheet in the student edition.
- Select additional activities to be inserted on the Learning Activities Sheet in the student edition.
- Copy the Written Test, optional assignment sheet, crossword puzzles, and Module Review for distribution to your students.
- Prepare supplemental resources for use by your students.

DELIVERY AND APPLICATION

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.

EVALUATION

- Give the Written Test. Reteach and retest as required.
- Review with students the remaining component in the student edition: Assignment Sheet 1, "Practice Critical Thinking: Complete Biochemistry and Microbiology Case Studies."
- Have students complete the assignment sheet.
- Give the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Reteach and retest as required.

TEACHING SUGGESTIONS

✔ **NOTE:** This module focuses on the cellular level of organic structures as introduced in Module 1. This approach is used to get across two vital concepts: (1) the biological and chemical composition of organisms and (2) the similarities and differences between single-cell organisms and the cellular structure and metabolism of the human body. Many students are likely to be intimidated by subjects such as chemistry and biology. By emphasizing the building-block organization of the module's objectives, you should be able to guide them comfortably through the material.

- Use crosswword puzzles 1 through 7 to help reinforce the terms in the associated objectives.
- If your facility includes instruction in sciences such as chemistry and biology, check with other instructors about possible resources for use with this module. Helpful materials include a model of an atom, a periodic table of the elements, microscopes and prepared slides, and other materials.
- Show students the three states of matter. For example, water and ice are easily shown and the existence of vaporous (gaseous) states can be demonstrated by the condensation on the side of a glass where water vapor in the air is cooled to form liquid droplets. Discuss the chemical formula for water (H_2O) and how that is basic chemistry. Point out that water is an important component of the body.
- Use histology illustrations from catalogs or other sources to introduce the concept of cells and cellular structure. You may want to use a microscope to show students organisms in a drop of water or epithelial cells from inside the cheek within the oral cavity. Relate the term *microscope* to *microbiology*.
- Discuss the basic chemistry of nutrition—food, vitamins, minerals, supplements, sugars, starches, etc.—as an introduction to body chemistry. Relate normal chemical functioning to homeostasis.
- Use models and illustrations to discuss atomic structure, relating the concept to elements. Use a periodic table if available. Discuss how atoms can combine to form molecules and create compounds.
- Demonstrate compounds, mixtures, and solutions. One good way to make a mixture is to combine iron filings with sawdust. A magnet can be used to separate the two components of the mixture. In demonstrating solutions, use salt or sugar and water to

show how a substance can dissolve in a liquid. Add the material until the saturation point is reached and then stir the solution or heat it to show how the addition of energy can increase the liquid's capacity to dissolve.

- Provide samples of the various common chemicals in the body and others as you deem appropriate for your program. Discuss the roles of these chemicals in physiology.
- If your chemical skills are adequate, demonstrate the various types of chemical reactions and the rules that govern them.
- Provide samples of the types of organic compounds and discuss their roles in the body.
- Relate body fluids to types of solutions. Lead the students in discussing how the body as a container filled with solution can be affected by chemical balance and the dynamics of solutions.
- Demonstrate pH and have the students test common substances (orange juice, cola, water, milk, etc.). Also have them test body fluids if safe supplies are available.
- Discuss metabolism and factors such as hunger, weight gain or loss, exercise, etc. Provide students with calorie charts and have them calculate the calories in various foods and the calories burned in various types of exercise. Have students track their calorie intake and burn-rate for a week and arrive at conclusions about their own metabolism.
- Have students measure their own or the temperatures of others using various types of thermometers. Compare results for various times of day, before and after exercise, before and after meals, etc. Discuss body responses to heat and cold and how they may help homeostasis.
- Have the students to provide examples of the basic activities that define life and relate those activities to various life forms, including plants.
- Relate cell composition to the study of chemicals. Use a variety of cell types to discuss parts of a cell so that students understand that the module presents a stylized cell and so the students can correlate the parts of a cell to various structural arrangements.
- Observe actual cells to observe the actions of specialized structures.
- Use dyes and cells on slides to demonstrate transport and methods of transport.
- Use illustrations and animated features to assist with the discussions of cell growth and reproduction. Prepared slides are also available.
- Discuss the mechanics of mutations and internal and external causes. Discuss the role of natural selection in the changes of species over time. With the current advances in the mapping of the human genome, have students obtain information about gene associations and defects, especially as they relate to health.
- Compare and contrast types of cellular respiration.
- Have students do the taxonomic classification of various types of organisms, including humans. Have students find examples of the various types of relationships between organisms and provide the taxonomic classifications for the organisms involved.

- Provide slides, illustrations, models, or actual specimens of the various microorganisms. Point out that many arthropods are visible to the eye; however, several species are virtually invisible without magnification. The primary focus is that microorganisms may be pathogenic to humans.
- Demonstrate gram stains. Quiz the students in identifying organisms by gram stains and other methods.
- For Objectives 47 through 52, relate the organisms listed to their effects on human health and the required medical responses.

RESOURCES USED IN DEVELOPING THIS MODULE

- *Anatomy and Physiology.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1993.
- *Core Curriculum for Surgical Technology,* 4th ed. Englewood, CO: Association of Surgical Technologists, Inc., 1996.
- Gylys, Barbara A., and Regina Masters. *Medical Terminology Simplified,* 2nd ed. Philadelphia: F.A. Davis Company, 1998.
- Gray, Henry. *Gray's Anatomy,* 15th ed. New York: Gramery Books, 1977.
- Kwon-Chung, K. J., and John E. Bennett. *Medical Mycology.* Philadelphia: Lea and Febiger, 1992.
- Scanlon, Valerie C. *Essentials of Anatomy and Physiology,* 3rd ed. Philadelphia: F.A. Davis Company, 1999.
- Sherris, David A., and Eugene B. Kern. *Basic Surgical Skills.* Rochester, MN: Mayo Foundation for Medical Education and Research, 1999.
- Thibodeau, Gary A., and Kevin T. Patton. *Anatomy and Physiology,* 4th ed. St. Louis: Mosby, Inc., 1999.

SUGGESTED WEB SITES*

✔ **NOTE:** The following web sites offer general information about anatomy and physiology and generally cover more than one body system. Later modules list sites specific to the systems and disorders presented in that module. These sites can be used in a general way with the first four modules included in Module Set I and for specific portions of the sites as they relate to the systems covered in later modules in Module Set II.

- http://harveyproject.org

  The Harvey Project is an international collaboration of educators, researchers, physicians, students, programmers, instructional designers, and graphic artists working together to build interactive, dynamic human physiology course materials on the World Wide Web. Materials produced by the Harvey Project are available free to educational institutions. The site is constantly updated and should be checked often and browsed for overall content. The address provided is for the home page. By clicking the WEB button, you will be taken to an index of links divided into categories such as general physiology and specific systems. The number of links in each category is indicated in parentheses after the topic.

- http://www.hapsweb.org/

  The Human Anatomy and Physiology Society (HAPS) was founded to promote communications among teachers of human anatomy and physiology in colleges, universities, and related institutions; to present workshops and conferences where members can obtain information about the latest developments in the health and sciences fields; and to encourage educational research and publication by HAPS members. The site contains information about society resources, including a newsletter, publications, and resources on the World Wide Web.

- http://www.niagra.edu/~bcliff/hapcstop.html

  This site contains case studies for all AST subject areas. The case studies are free to use as long as their source is acknowledged.

- http://www.nim.nih.gov/research/visible/visible_human.html

  The Visible Human Project's objective is to create complete, anatomically detailed, three-dimensional representations of the normal male and female human bodies. The site contains CT, MR, and cryosection images of male and female cadavers. The male is sectioned at one-millimeter intervals, while the female is sectioned at one-third-of-a-millimeter intervals.

- http://edtech.nepean.uws.edu.au/science/ap/index.html

  This anatomy and physiology resource page contains information, images, suggestions, tips, and stimuli to students preparing for a career in health services. Although based on Australian requirements, much of the information is useful for students in other nations.

- http://www.innerbody.com/htm/body.html

  This site provides a great deal of information on the human body in fun, interactive formats. There is a great deal of emphasis on terminology and body parts.

- http://www.orthop.washington.edu/Bone%20and%20Sources/Sources.idx.html

  Sponsored by the University of Washington, this site offers information on orthopedic-related subjects and links to similar sites.

- http://tray.dermatology.uiowa.edu/DermImag.htm

  This site offers many images of the skin and underlying tissues.

- http://www.ctru.auckland.ac.nz/atlas/intro/cardiac.htm

  This site offers an atlas that provides nearly 100 cross-sectional views of the cardiac anatomy created with an MRI scanner. The views are labeled and taken along different axes.

- http://www.prenhall.com/martini/

  This site is geared to five Prentice-Hall textbooks and offers a variety of self-grading quizzes, links to other web sites, a forum for student discussion, and other resources.

- http://www.heartsite.com/index.html

  Although designed for patients with heart-related complaints, this site contains a great deal of information about the heart and its disorders.

- http://www.merck.com/health/

  This site provides a general guide to health that addresses many of the disorders covered in this curriculum.

- http://www-sci.lib.uci.edu/~martindale/MedicalAnatomy.html

  This site provides a wealth of information and many useful graphics about human anatomy.

- http://www.uchsc.edu/sm/chs/gallery/gallery.htm

  This link goes directly to the gallery portion of the Visible Body Project at the University of Colorado.

- http://sln.fi.edu/biosci/biosci.html

  This site allows students to explore the heart, its structure and development, the flow of blood, and its relationship to other body systems. It also presents information about heart health and the history of heart science.

- http://www.maui.net/~jms/brainuse.html

  This site deals primarily with the brain and offers many useful graphics.

- http://www.cid.ch/DAVID/Mainmenu.html

  This is a rich gallery of CAT scans that can be explored through links to various sections of the body.

- http://www.meddean.luc/lumen/MedEd/GrossAnatomy/GA.html

  This site provides many images that include laboratory slides and anatomical cross-sections.

- http://www.med.umich.edu/lrc/Atlas/atlas.html

  ATLAS-plus integrates the use of digitized images, computer graphics, sound, animations, and textual information to teach basic concepts and principles of human anatomy through three courses: gross anatomy, histology, and embryology. The gross-anatomy course includes systemic components and dissection images.

- http://www.rad.washington.edu/anatomy/index.html

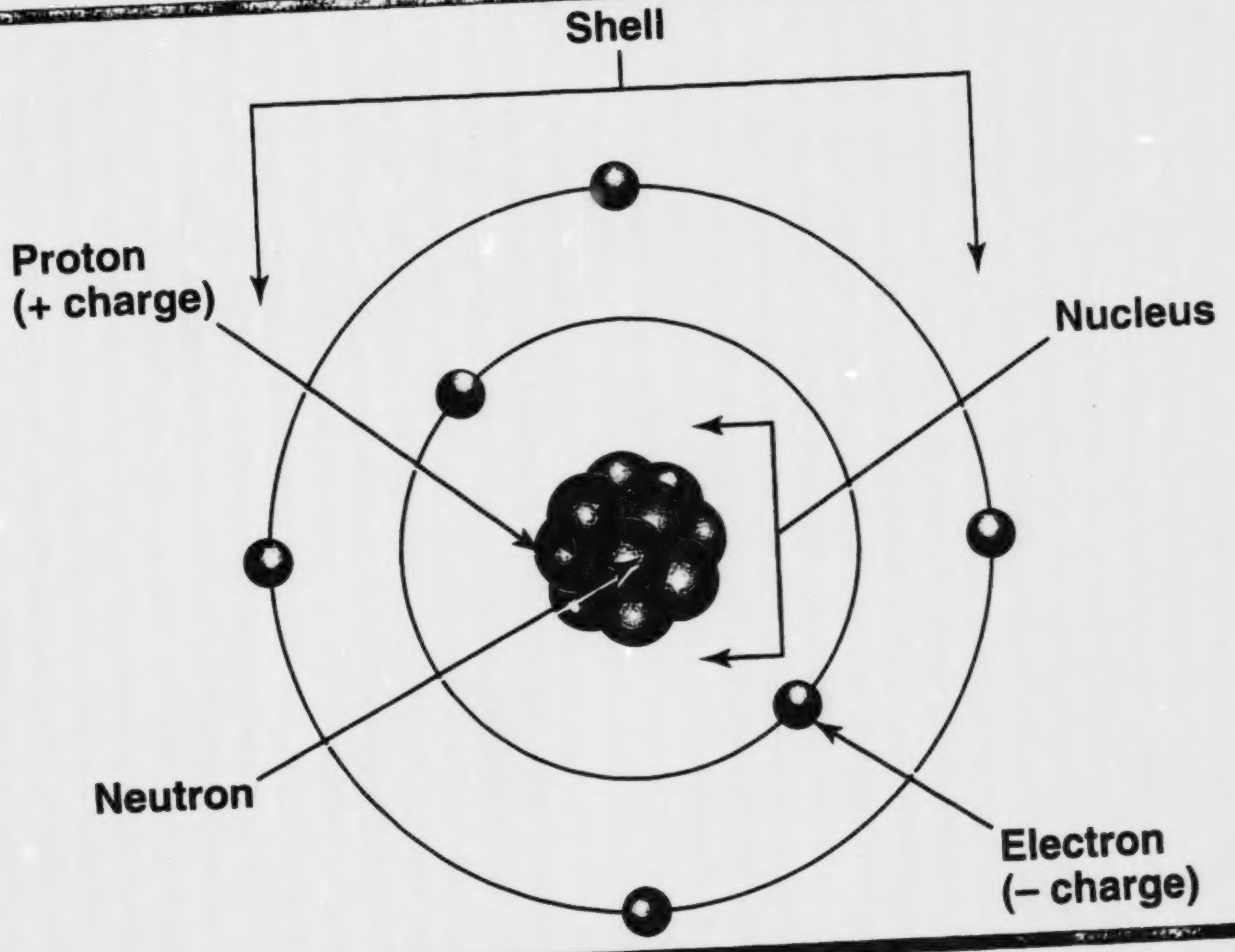
  This site features radiological images of the body and the skeletal system.

- http://www9.biostr.washingron.edu/da.html

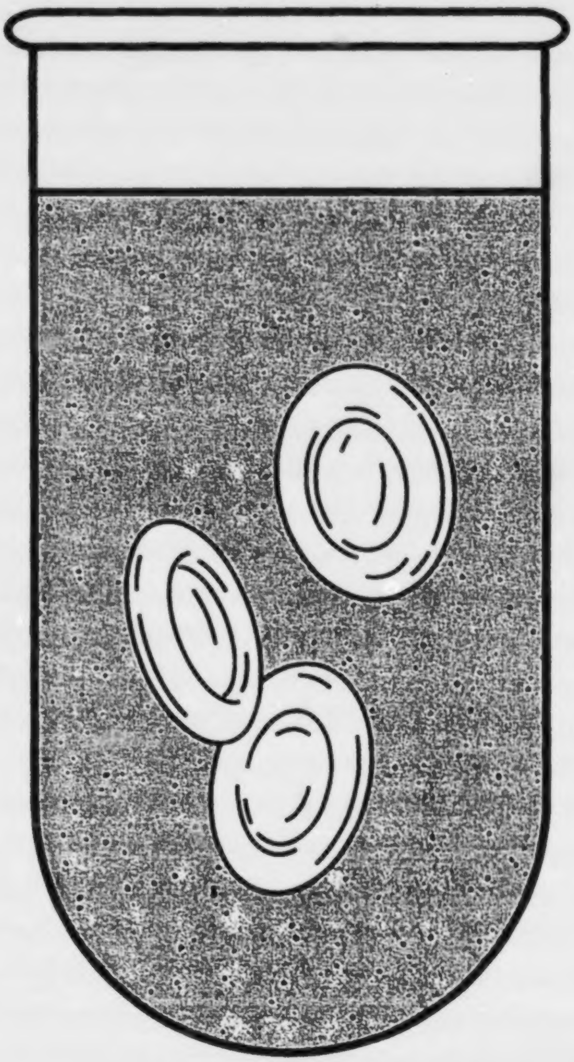
  This site provides images and information in four areas: the brain, neuroanatomy, thoracic viscera, and the knee.

*Web-site addresses were accurate and all content on referenced web sites was appropriate during development and production of this product. However, web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all web sites prior to use.

Parts of an Atom

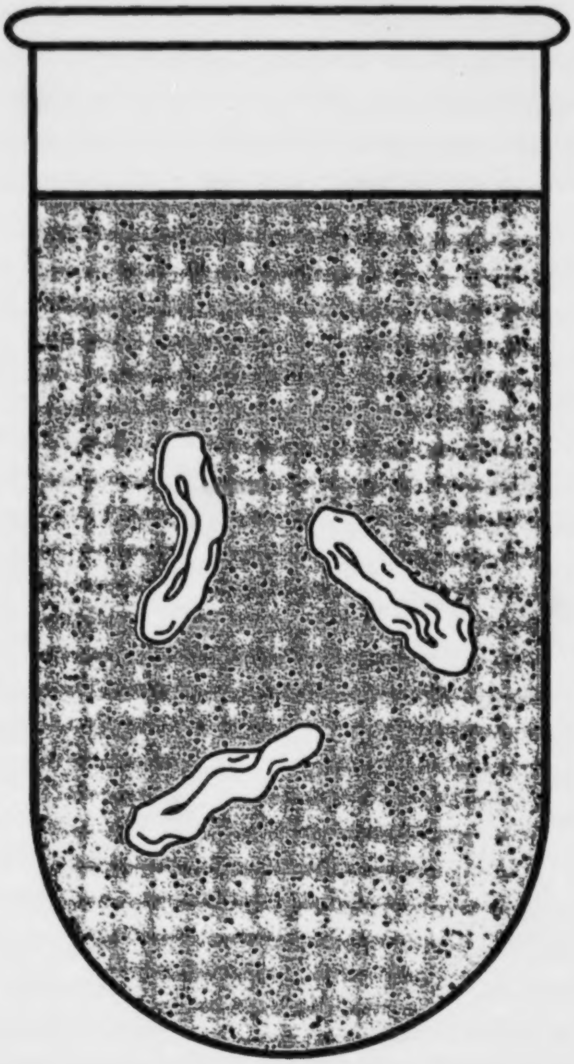

Shell
Proton
(+ charge)
Nucleus
Neutron
Electron
(– charge)

Types of Solutions: Isotonic



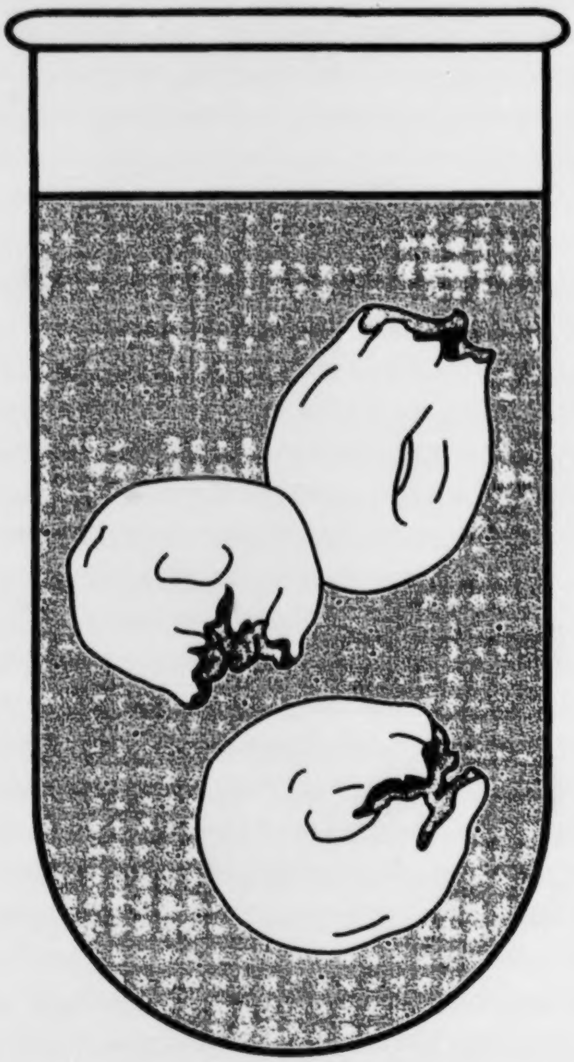
The concentration of dissolved minerals inside the cells is normally the same as that in the plasma, thus there is no flow between the internal and external solutions.

Types of Solutions: Hypertonic



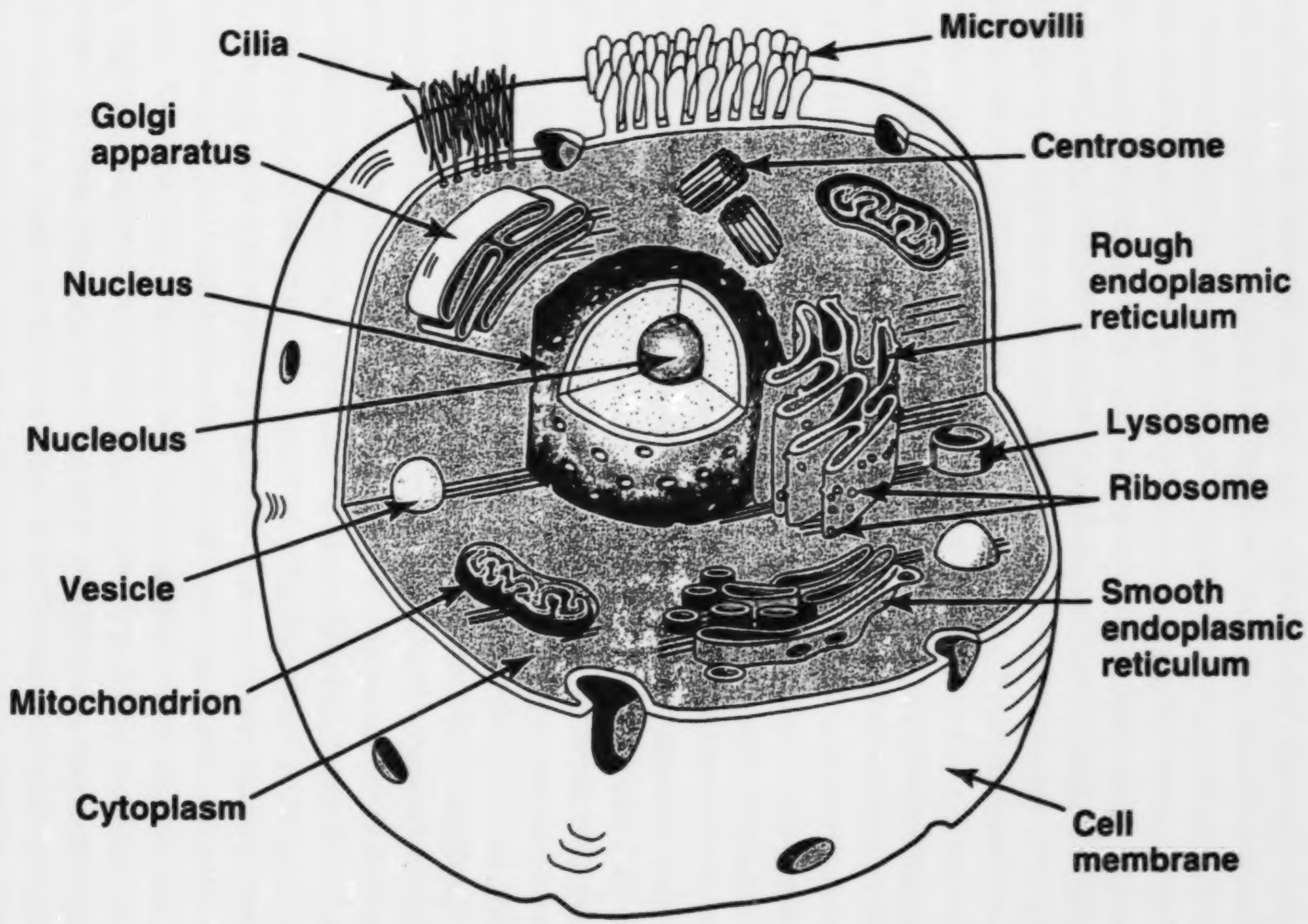
The concentration of the solution surrounding the cells is greater than that of the cells. Material will flow from the surrounding solution to the cells.

Types of Solutions: Hypotonic

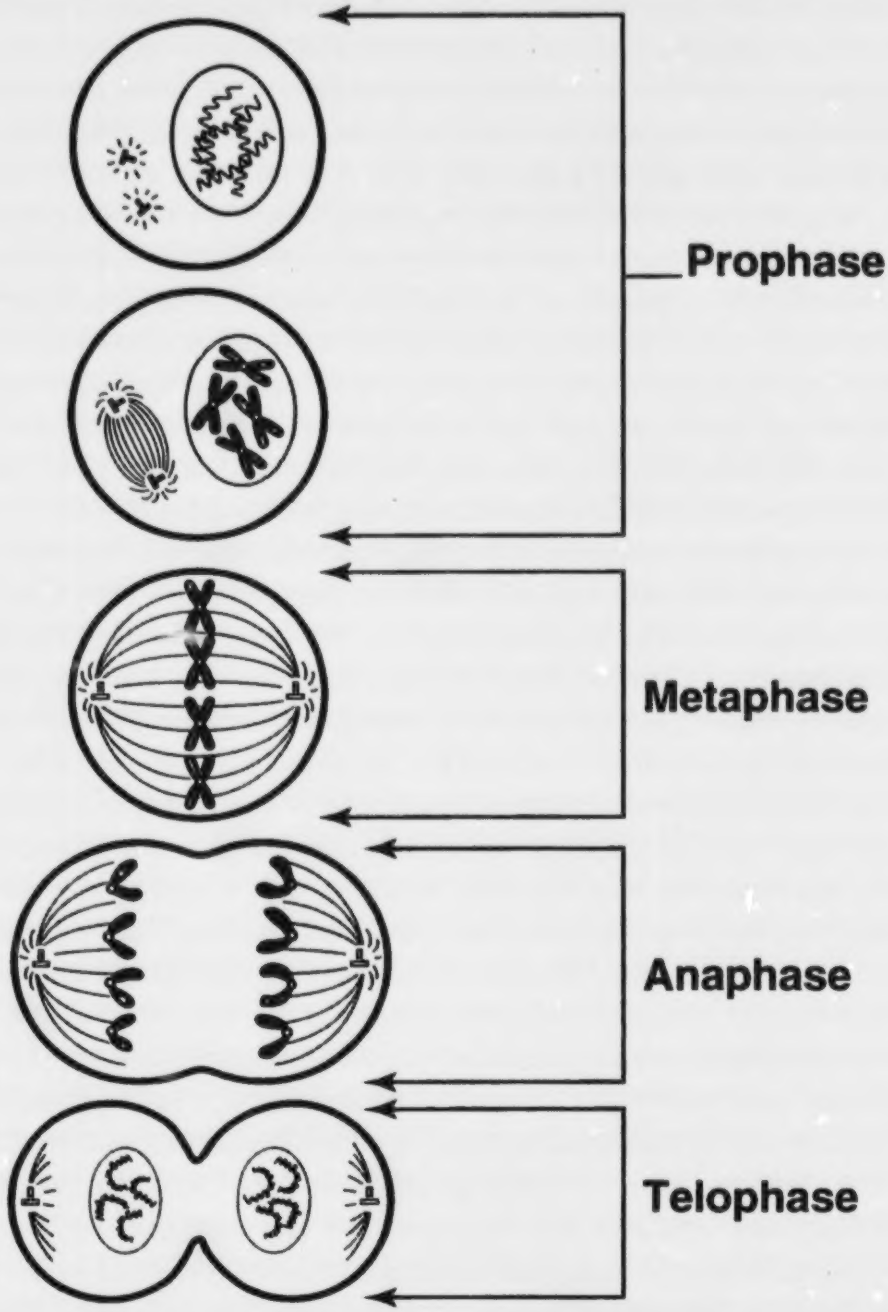


The concentration in the cells is greater than that in the surrounding solution. The material in the cells ruptures the cells to create an equilibrium in the surrounding solution.

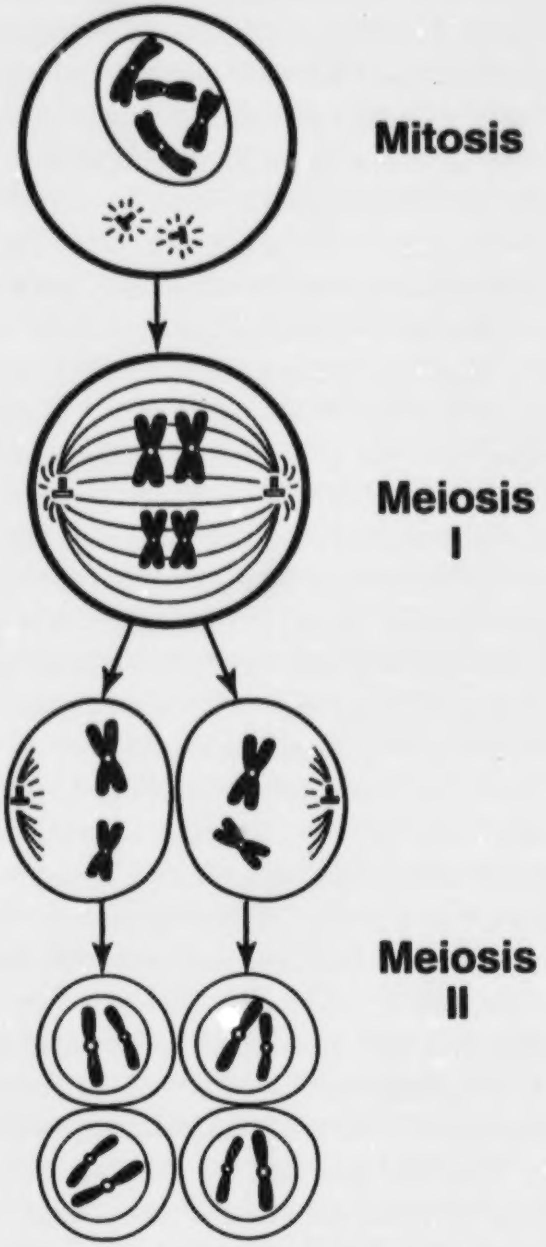
Major Parts of a Cell


Cilia
Microvilli
Golgi apparatus
Centrosome
Nucleus
Rough endoplasmic reticulum
Nucleolus
Lysosome
Ribosome
Vesicle
Smooth endoplasmic reticulum
Mitochondrion
Cytoplasm
Cell membrane

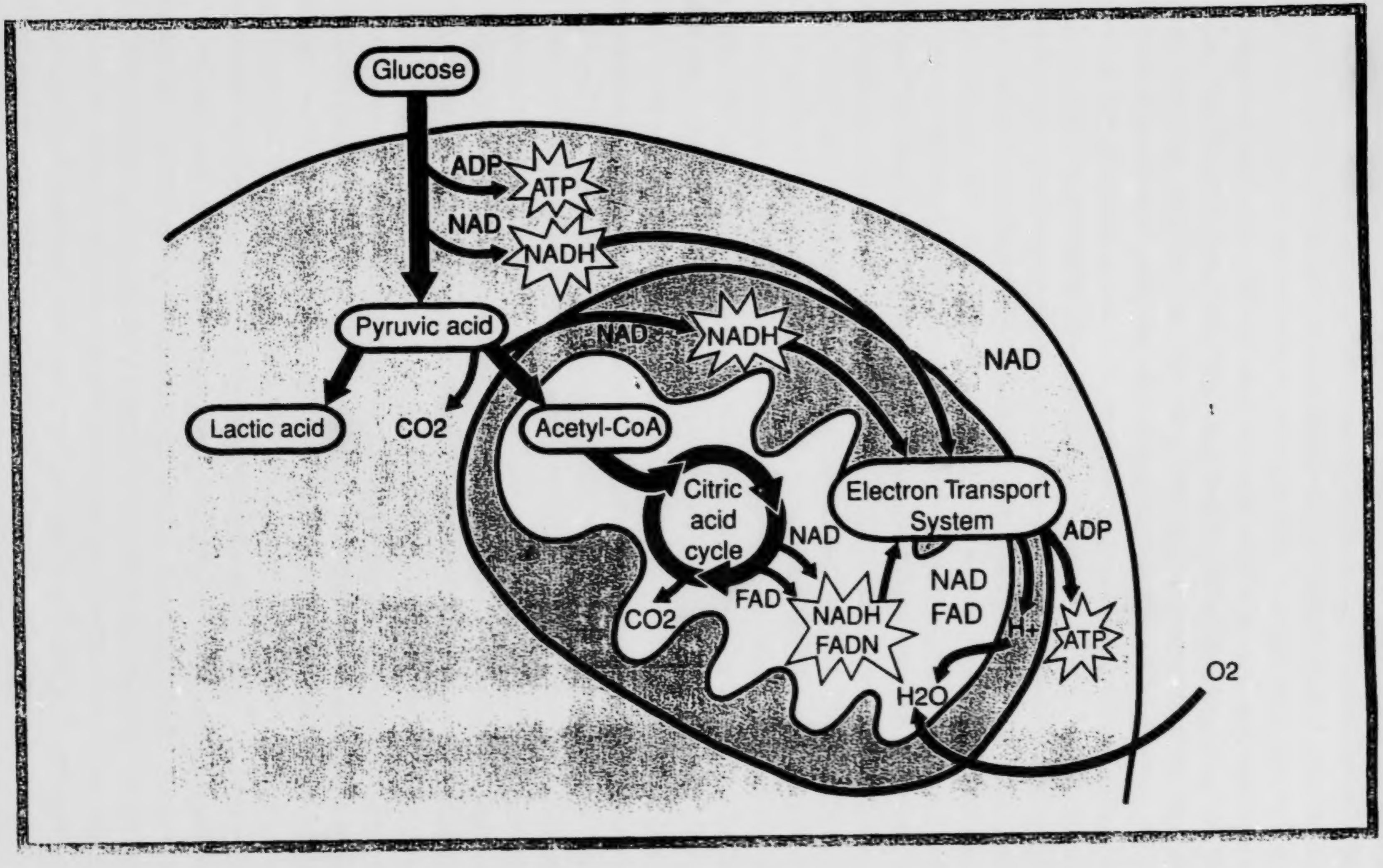
Types of Cell Reproduction: Mitosis


Prophase
Metaphase
Anaphase
Telophase

Types of Cell Reproduction: Meiosis

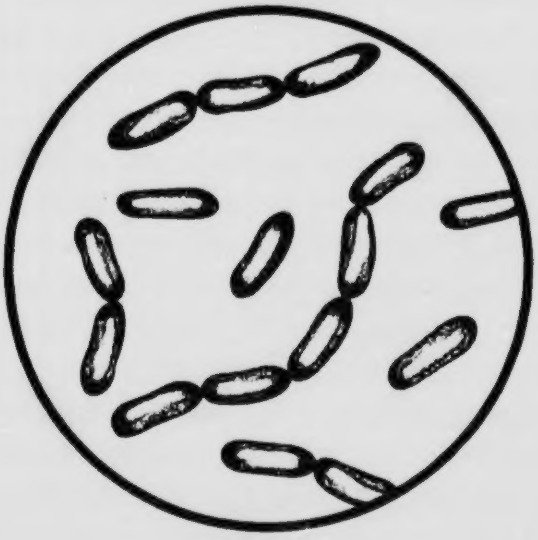

Mitosis
Meiosis I
Meiosis II

Cell Respiration

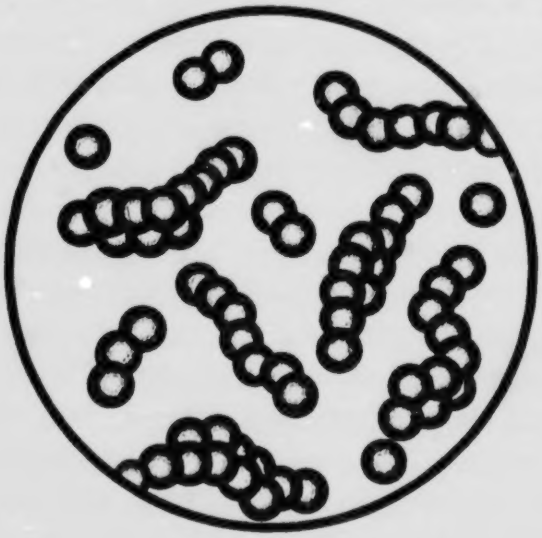

Glucose
ADP
ATP
NAD
NADH
Pyruvic acid
NAD
NADH
NAD
Lactic acid
CO2
Acetyl-CoA
Citric
acid
cycle
NAD
FAD
CO2
NADH
FADN
Electron Transport
System
ADP
NAD
FAD
H+
ATP
H2O
O2

BEST COPY AVAILABLE

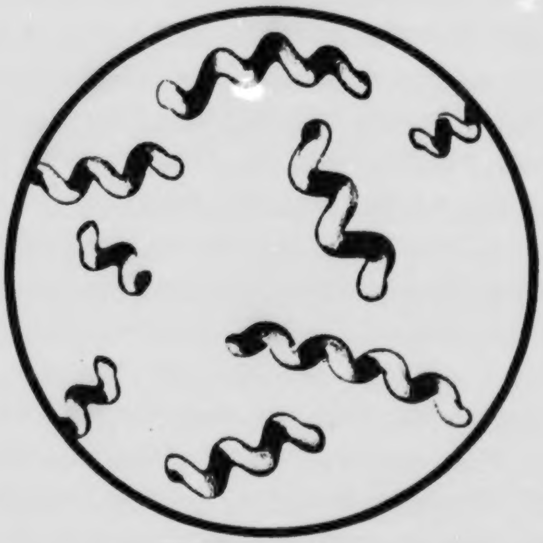
Classes of Microorganisms



Bacillum



Coccus



Spirillum

Written Test

Name ______________________________

Date ____________________ Score ____________________

OBJECTIVE 1 Define the terms *biochemistry* and *microbiology*. Write your answers on the blank lines provided beside the terms below.

a. Biochemistry ______________________________

____

b. Microbiology ______________________________

____

OBJECTIVE 2 Discuss the role of chemistry in human health. Write your answer on the blank lines provided below.

____

____

____

____

____

____

____

OBJECTIVE 3 Define the term *homeostasis*. Write your answer on the blank lines provided beside the term below.

Homeostasis ______________________________

____

OBJECTIVE 4 Define the term *element*. Write your answer on the blank lines provided beside the term below.

Element ______________________________

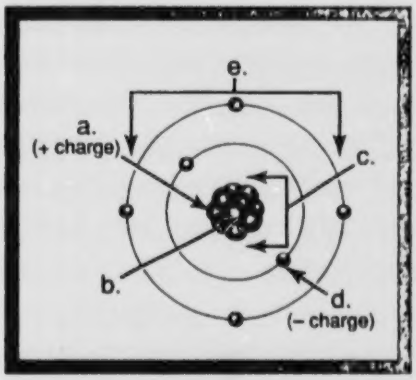
____

OBJECTIVE 5 Define the term *atom*. Write your answer on the blank lines provided beside the term below.

Atom ____

____

OBJECTIVE 6 Label the parts of an atom. Write your answers on the blank lines provided beside the illustration below.



a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

OBJECTIVE 7 Define the term *molecule*. Write your answer on the blanks lines provided beside the term below.

Molecule ____

____

OBJECTIVE 8 Distinguish among the definitions of the terms *compound, mixture,* and *solution*. Write a "C" on the blank before the definition of a compound, an "M" before the definition of a mixture, and an "S" before the definition of a solution.

______ a. A substance that consists of two or more combined components that do not interact chemically; to separate its components requires either a mechanical method or the application of energy

______ b. A substance that consists of atoms of two or more different elements bonded together as molecules; to separate its components into other compounds and elements requires a chemical reaction

______ c. A substance that consists of one or more components dissolved in a liquid; to separate its components, the energy of the substance must change so that the energy balance between the components prevents the liquid from being able to hold the dissolved material

OBJECTIVE 9

Describe the primary role of each of the principal elements and compounds in the body. Write your answers on the blank lines provided beside the terms below.

a. Carbon dioxide ______________________________

____

b. Glucose ______________________________

____

c. Oxygen ______________________________

____

d. Water ______________________________

____

OBJECTIVE 10

Complete statements that describe the chemical reactions that take place in the body. Write your answers on the blank lines provided in the statements below.

a. A chemical reaction involves an interaction between two or more chemicals that results in matter with a different ____________________ from the chemicals that were originally introduced into the reaction.

b. A reaction that causes atoms or molecules to bond, thus producing different chemicals, is called a ____________________ reaction.

c. A reaction that causes molecule bonds to break is called a ____________________ reaction.

d. ____________________ reactions are necessary to allow the body to build proteins and other building blocks of cells and tissue.

e. ____________________ reactions are necessary to allow the body to break down the large, complex molecules of nutrients into small, easily transported molecules that the cells can use to sustain life.

f. ______________ or ______________ can be added to a chemical reaction to increase the rate of reaction.

g. The failure to provide the ____________________ in the proper proportions, the introduction of additional ____________________, or the failure to provide a required ____________________ or ____________________ can prevent the reaction from happening.

OBJECTIVE 11

State the functions of the major types of organic compounds in the body. Write your answers on the blank lines provided beside the terms below.

a. Carbohydrates ____

____

____

b. Lipids ____

____

____

c. Proteins ____

____

____

d. Nucleic acids ____

____

____

OBJECTIVE 12

Complete phrases that describe the components of the major types of organic compounds in the body. Write your answers on the blank lines provided in the phrases below and on the next pages.

1. **Carbohydrates**
   a. Consist primarily of ________________ or ________________
   b. Include ________________, which are simple sugars that provide nutrient energy and form other compounds
   c. Include ________________ and ________________, which are part of the nucleic acids that form the genetic code in cells
   d. Include ________________, which serve as antigens on the outer surface of cell membranes
   e. Include ________________, an indigestible substance that provides bulk to the contents of the digestive tract and promotes healthy movement through the intestines

f. Include ____________________, which consists of a very-complex chain of glucose molecules that can be stored in the liver and skeletal muscles until converted back into glucose

g. Include ____________________, which consist of chains of glucose that are split apart during digestion

2. **Lipids**

a. Consist of ____________________, ____________________, and sometimes ____________________, often in the form of fatty acids

b. Include ____________________, which store energy primarily in the form of body fat

c. Include ____________________, which are one constituent of cell membranes

d. Include ____________________, which are one constituent of cell membranes and assist with hormone synthesis

e. Include ____________________, which regulate hormone action, enhance the immune system, and affect the inflammatory response

3. **Proteins**

a. Consist of ____________________________, which are made of carbon, hydrogen, oxygen, nitrogen, and in some cases, sulfur

b. Include ____________________, ____________________, ____________________, ____________________, and other structural proteins that form receptor sites in cell membranes

c. Include ____________________, which regulate body functions including growth, sexual maturation, and cell functions

d. Include ____________________, which tag harmful substances in the body so that they will be destroyed

e. Include ____________________, which serve as catalysts in chemical reactions

4. **Nucleic acids**

    a. Consist of ____________________, which are made of a pentose sugar, a phosphate group, and one of five base chemicals that include nitrogen

    b. Include ____________________________________, which is a double strand of nucleotides with a structure that defines the code of inherited traits

    c. Include ____________________________________, which is a single strand of nucleotides that synthesizes protein

OBJECTIVE 13 Complete statements that describe the major elements and compounds that compose the body. Write your answers on the blank lines provided in the statements below.

a. More than ____________________ elements are found in the human body.

b. ____________________ is the most-common element in the body by total weight, at approximately 65 percent.

c. ____________________, at nearly 19 percent, and ____________________, at nearly 10 percent, are the other large constituents.

d. There are also minor quantities of ____________________, ____________________, and ____________________.

e. There are __________________________—less than 0.1 percent—of a number of minerals, including manganese, iron, cobalt, copper, zinc, and others, as well as iodine and chlorine.

OBJECTIVE 14 Define types of solutions. Write your answers on the blank lines provided beside the terms below.

a. Hypertonic ____

____

b. Hypotonic ____

____

c. Isotonic ____

____

OBJECTIVE 15 Define the major types of fluid in the body. Write your answers on the blank lines provided beside each of the terms below.

a. Intracellular fluid ______________________________

b. Interstitial fluid ______________________________

c. Plasma ______________________________

OBJECTIVE 16 Define the term *electrolyte*. Write your answer on the blanks lines provided beside the term below.

Electrolyte ______________________________

OBJECTIVE 17 Discuss the role of electrolytes in human health. Write your answer on the blank lines provided below.

Objective 18

Discuss the role of acids and bases in human health. Write your answer on the blank lines provided below.

Objective 19

Define the term *metabolism*. Write your answer on the blanks lines provided beside the term below.

Metabolism ______________________________

Objective 20

Complete statements that describe the use of energy by the body. Write your answers on the blank lines provided in the statements below and on the next page.

a. The primary source of energy in the body is ______________________ (ATP).

b. During cell metabolism in which ______________ and ______________ are converted into carbon dioxide and water, some of the energy released creates a bond between ADP and a phosphate group to produce ATP.

c. ______________ is stored in the phosphate bonds of ATP until it is needed for cell functions.

d. All cells contain ______________ that allow them to break the phosphate bonds in ATP.

e. Energy released from ATP fuels cell functions, including ____________________ to produce new cells.

f. Some of the energy is applied to moving substances in and out of the cell and in carrying out chemical reactions, as well as providing the cell with a stable ____________________.

OBJECTIVE 21 Complete statements that describe the characteristics of body temperature. Write your answers on the blank lines provided in the statements below.

a. Normal body temperature ranges from ______________°F to ______________°F (______________°C to ______________°C).

b. Normal temperature is considered to be ______________°F (______________°C).

c. Temperature is normally ______________ during sleep.

d. Body temperature is regulated by the ______________.

e. Blood vessels near the surface of the skin ______________ to reduce heat loss.

f. Blood vessels near the surface of the skin ______________ to increase heat loss.

g. Heat is removed from the body by ______________.

h. ______________ is an abnormally high body temperature.

i. ______________ is an abnormally low body temperature.

OBJECTIVE 22 State definitions of the basic activities that define life. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Reproduction ____

____

b. Growth ____

____

c. Metabolism ____

____

d. Movement ______

e. Responsiveness ______

f. Adaptation ______

Objective 23 State the cell theory. Write your answer on the blanks lines provided below.

______

Objective 24 State the functions of the compounds found in protoplasm. Write your answers on the blank lines provided beside the terms below.

a. Water ______

b. Protein ______

c. Carbohydrates ______

d. Fats ______

e. Nucleic acids ______

f. Mineral salts ______

Objective 25 Define the principal types of protoplasm. Write your answers on the blank lines provided beside the terms below and on the next page.

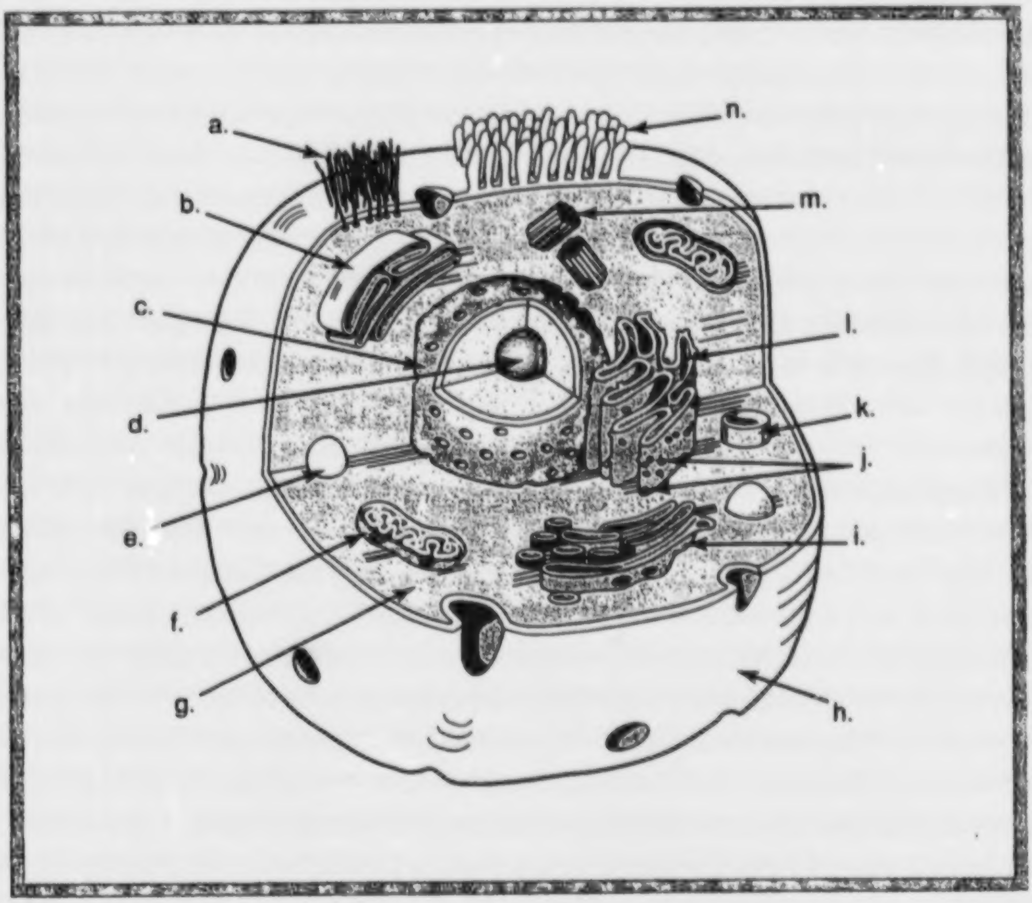
a. Cytoplasm ______

b. Nucleoplasm ____

____

OBJECTIVE 26

Label the major parts of a cell. Write your answers on the blank lines provided under the illustration below.



a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

i. ____________________

j. ____________________

k. ____________________

l. ____________________

m. ____________________

n. ____________________

OBJECTIVE 27

Match the major parts of a cell to their correct functions. Write the numbers on the blanks provided.

1. Cell membrane
2. Nucleus
3. Centrosome
4. Cytoplasm
5. Endoplasmic reticulum
6. Golgi apparatus
7. Lysosome
8. Mitochondrion
9. Ribosome

_______ a. Contains the enzymes used to digest ingested material and damaged tissue

_______ b. Synthesizes carbohydrates and packages materials to prepare them for secretion from the cell

_______ c. Synthesizes protein

_______ d. Provides a passageway for the transport of materials within the cell and synthesizes lipids

_______ e. Regulates cellular structure and activities, including reproduction of the cell

_______ f. Provides structure to the cell and supports other parts of the cell

_______ g. Allows some molecules to enter the cell while preventing entry by other molecules

_______ h. Organizes special spindle fibers during cell division

_______ i. Produces ATP and serves as the site of cell respiration

OBJECTIVE 28

Describe the major parts of a cell nucleus. Write your answers on the blank lines provided beside each of the terms below.

a. Chromosome ____

____

b. Nuclear membrane ____

____

c. Nucleolus ____

____

OBJECTIVE 29

Describe the specialized structures in cells. Write your answers on the blank lines provided beside the terms below and on the next page.

a. Cilia ____

____

b. Flagellum ____

____

c. Microvilli ______________________________

____

OBJECTIVE 30 State the functions of the specialized structures in cells. Write your answers on the blank lines provided beside the terms below.

a. Cilia ______________________________

____

b. Flagellum ______________________________

____

c. Microvilli ______________________________

____

OBJECTIVE 31 List seven of the eight functions of a cell. Write your answers on the blank lines provided below.

a. ______________________________
b. ______________________________
c. ______________________________
d. ______________________________
e. ______________________________
f. ______________________________
g. ______________________________

OBJECTIVE 32 Define the term *transport*. Write your answer on the blanks lines provided beside the term below.

Transport ______________________________

____

OBJECTIVE 33 Distinguish between descriptions of the terms *active transport* and *passive transport*. Put an "X" on the blank line before the description of passive transport.

_______ a. Movement that occurs without any energy being expended by the cell

_______ b. Movement that requires the use of energy for the cell to transport the material through the cell wall

OBJECTIVE 34 Match types of passive transport to their correct descriptions. Write the numbers on the blanks provided.

_______ a. The process by which solvents or specific particles are able to move through a membrane that prevents the passage of other solvents or particles

_______ b. The process by which solvent molecules pass through a semipermeable membrane to produce an equal concentration on each side of the membrane

_______ c. The process by which particles in a fluid spread throughout the fluid to produce an equal concentration

1. Diffusion
2. Filtration
3. Osmosis

OBJECTIVE 35 Match types of active transport to their correct descriptions. Write the numbers on the blanks provided.

_______ a. The process of a cell engulfing a solid particle with a portion of its membrane, which then breaks off from the membrane and migrates into the cell as a closed vesicle

_______ b. The process of a cell engulfing a liquid particle with a portion of its membrane, which then breaks off from the membrane and migrates into the cell as a closed vesicle

_______ c. The process of a cell carrying substances in vesicles and secreting through the cell membrane

_______ d. The process that moves molecules or ions through cell membranes against the pressure of natural forces

1. Exocytosis
2. Phagocytosis
3. Physiological pump
4. Pinocytosis

OBJECTIVE 36 Complete statements that describe the process of cell growth. Write your answers on the blanks provided in each of the statements below and on the next page.

a. Once a cell forms, it must produce additional __________________ and __________________ as the cell enlarges.

b. Part of the growth process involves protein synthesis through __________________.

c. During protein synthesis, __________________ are bonded in polypeptide chains.

d. To create the polypeptide chains, a ________________ attaches to a complementary set of RNA molecules—a ________________ molecule and a ________________ strand—and holds them together during protein synthesis.

e. The ________________ are drawn to the ribosome.

f. The ribosome secretes an ________________ that promotes the formation of a peptide bond.

g. The ribosome moves along the RNA strand pair building ________________.

h. In some cases, after the ribosome travels the full length of the RNA strands and moves on, ________________ present in the cell connect the polypeptides to form proteins.

i. Other ________________ cause the ________________ to form cell membrane and organelles.

j. ________________ increase by self-replication.

k. Just before the cell begins to reproduce, the ________________ also replicates itself.

OBJECTIVE 37 Describe the types of cell reproduction. Write your answers on the blank lines provided beside the terms below.

a. Mitosis ____

____

____

b. Meiosis ____

____

____

OBJECTIVE 38 Describe the process in which the genetic makeup of a cell can be changed. Write your answer on the blank lines provided below.

____

____

____

____

OBJECTIVE 39

List the sources of mutation-causing conditions. Write your answers on the blank lines provided below.

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

OBJECTIVE 40

Match the types of cellular respiration to their correct descriptions. Write the numbers on the blanks provided. Answers will be used more than once.

1. Glycolysis 2. Aerobic oxidation 3. Electron transport system

_______ a. Uses enzymes located in the cytoplasm

_______ b. Uses enzymes located in the mitochondria

_______ c. Uses proteins located in the mitochondria

_______ d. Requires oxygen

_______ e. Does not require oxygen

_______ f. Requires the vitamins riboflavin and niacin and the minerals iron and copper

_______ g. Requires the vitamins thiamine, riboflavin, and niacin

_______ h. Requires the vitamin niacin

_______ i. Requires two molecules of ATP to start the reaction

_______ j. Converts pyruvic acid into one ATP molecule, hydrogen, carbon dioxide, and carbon molecules

_______ k. Combines hydrogen and oxygen released from other forms of respiration to produce water

_______ l. May develop into aerobic oxidation once oxygen is available

_______ m. May continue through additional cycles as carbon combines with acetyl coenzyme A

_______ n. Allows the electrons released by hydrogen atoms to react with cytochromes to generate enough energy to produce 34 ATP molecules from each glucose molecule

_______ o. Converts glucose and two ATP molecules into four ATP molecules, hydrogen, and energy

OBJECTIVE 41

Arrange in order the levels in the taxonomy system used to classify organisms. Write the numbers 1 through 7 next to each level below, arranging the levels from the broadest to the most specific.

______ a. Family

______ b. Species

______ c. Kingdom

______ d. Order

______ e. Genus

______ f. Class

______ g. Phylum

OBJECTIVE 42

Match the types of relationships between organisms to their correct descriptions. Write the numbers on the blanks provided.

______ a. A relationship between two organisms that have close contact with each other

______ b. A relationship between two organisms that is beneficial to both

______ c. A relationship between two organisms in which one organism is capable of causing a disease in the other organism

______ d. A relationship between two organisms in which the organisms present no significant benefit or harm to each other

______ e. A relationship between two organisms in which one organism benefits and the other neither benefits nor is harmed

______ f. A relationship between two organisms in which one organism is harmed by the presence of the other

1. Commensalism
2. Mutualism
3. Neutralism
4. Parasitism
5. Pathogenic
6. Symbiosis

OBJECTIVE 43

Describe the classes of microorganisms. Write your answers on the blank lines provided beside the terms below and on the next page.

a. Arthropod ______________________________

____

b. Bacterium ______________________________

____

c. Fungus ______________________________

____

d. Protozoan ______________________________

____

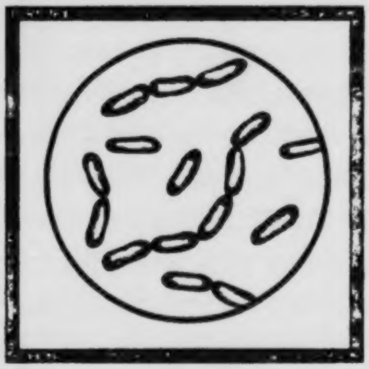
e. Virus ______________________________

____

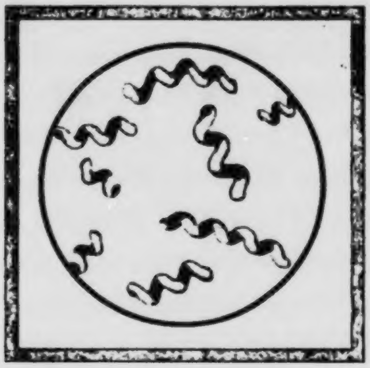
f. Worm ______________________________

____

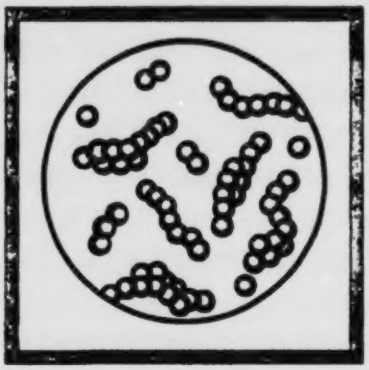
OBJECTIVE 44 Label the classes of microorganisms as classified by their shape. Write your answers on the blank lines provided under each of the following illustrations.



a. ______________________________



b. ______________________________



c. ______________________________

OBJECTIVE 45

Define the terms *resident flora* and *transient flora*. Write your answers on the blank lines provided beside the terms below.

a. Resident flora ____

____

b. Transient flora ____

____

OBJECTIVE 46

Describe the purpose of a gram stain. Write your answer on the blank lines provided beside the term below.

Gram stain ____

____

____

OBJECTIVE 47

Complete statements that describe the characteristics of bacteria. Write your answers on the blank lines provided in each of the statements below.

a. The tough ____________________ gives a bacterium its shape.

b. ____________________ and ____________________ often colonize with each other so that another way of identifying bacteria is by the shape of their colonies.

c. Bacteria reproduce by ____________________, in which the chromosome duplicates itself and then the cell divides into two identical cells.

d. ____________________ species require that oxygen be present in order to reproduce.

e. ____________________ species require that no oxygen be present in order to reproduce.

f. ____________________ species can reproduce with or without oxygen.

OBJECTIVE 48

Complete statements that describe the characteristics of rickettsiae. Write your answers on the blank lines provided in each of the statements below.

a. Rickettsiae are ____________________ that can reproduce only within the cells of a living host.

b. Rickettsiae infect mammals and are often spread by ____________________.

c. Rickettsiae infections can be treated with ____________________.

OBJECTIVE 49

Complete statements that describe the characteristics of viruses. Write your answers on the blank lines provided in each of the statements below.

a. Viruses are nucleic acids within shells of ______________.

b. Each virus exhibits a ______________ that is characteristic of that virus.

c. Viruses can only ______________ when they are within the living cells of a host organism.

d. A virus will use the __________________ and ______________ of an infected cell to produce other viruses, often multiplying to the point that the host cell ruptures and dies.

e. The severity of a viral disease depends on __________________________.

f. Some viruses can become ______________ so that they present no signs of infection and then become ______________ again after a period of time, even years later.

g. Some viruses can be transmitted from a ____________________________.

h. Antiviral medications are difficult to develop because viruses reside __________________, use the cell's chemicals to ______________, and offer few functions that can be ______________ without harming the host organism.

OBJECTIVE 50

Complete statements that describe the characteristics of protozoa. Write your answers on the blank lines provided in each of the statements below.

a. Protoza are ______________.

b. Protoza live in ______________ and ______________.

c. Protoza can form ______________ and become dormant.

d. Protoza generally spread from ______________ or ______________ contaminated with cysts.

OBJECTIVE 51

Complete statements that describe the characteristics of fungi and algae. Write your answers on the blank lines provided in each of the statements below.

1. **Fungi**

   a. Fungi may be ____________________ or ____________________.

   b. Some fungi are normally found in and on the ____________________.

   c. Fungi infections may result from the use of ____________________ or reduced ____________________ due to injuries or diseases.

   d. Most fungi infections are ____________________ but can spread to the inside of the body through ____________________.

2. **Algae**

   a. Algae may be ____________________ or ____________________.

   b. ____________________ generally occurs as a result of a break in the skin or a ____________________, including surgery, and is generally limited to the skin or ____________________.

   c. The most-common symptom is __________________________ that resemble many other conditions so that the diagnosis must be confirmed through __________________________.

OBJECTIVE 52

Complete statements that describe common parasites that afflict humans. Write your answers on the blank lines provided in each of the statements below and on the next page.

a. Parasitic worms live off ____________________ in the host's body, in the host's blood, or on the host itself.

b. Many parasitic worms have several stages of life involving ____________________, ____________________, and ____________________ stages.

c. Parasitic worms generally inhabit specific __________________________.

d. For some species of parasitic worms, the __________________________ varies with the stage of ____________________ and may even involve more than one host species.

e. ____________________ and ____________________ generally afflict the surface of a host's body and present little direct risk to the host.

f. Parasites such as lice, fleas, mosquitoes, and ticks may be ____________ of disease.

Answers to Written Test

Objective 1

a. The study of chemistry as it relates to life
b. The study of extremely small life

Objective 2

Discussion should include the following points.

- The body consists of various chemicals.
- Most body activities involve chemical reactions.
- For a person to remain healthy, the chemicals within the body must remain properly balanced.
- The body also produces special chemicals that regulate body functions.
- Chemicals entering the body from the external environment can affect the balance of chemicals within the body and can disrupt normal physiological chemical reactions.
- Injuries and diseases can change the chemical balance within the body and can disrupt chemical reactions.

Objective 3

The state of the body in which conditions remain relatively stable despite changes in the environment

Objective 4

One of more than 100 primary, simple substances that cannot be broken down by chemical means into any other substance

Objective 5

The smallest division of an element that exhibits all the properties and characteristics of the element

Objective 6

a. Proton (+ charge)
b. Neutron
c. Nucleus
d. Electron (– charge)
e. Shell

Objective 7

A structure consisting of two or more atoms

Objective 8

a. M
b. C
c. S

OBJECTIVE 9

a. Given off as a waste product of cell respiration

b. Serves as the primary energy source for the cells

c. Required for the chemical reaction that releases energy from nutrients; one of the atoms in a water molecule; a key element in other compounds of importance to the body

d. Dissolves substances to make them more usable to the body; provides fluid to lubricate moving parts of the body; helps to maintain body temperature

OBJECTIVE 10

a. chemical composition
b. synthesis
c. decomposition
d. Synthesis
e. Decomposition
f. Catalysts; energy
g. reactive chemicals; chemicals; catalyst; energy source

OBJECTIVE 11

a. Serve as the major source of energy

b. Serve as a means of storing energy, providing structure to cell membranes, and influencing some hormone functions

c. Serve many roles in the human body that can be generally classed as *functional*, in which the protein regulates a chemical reaction, or *structural*, in which the protein is a component in cells and tissues

d. Serve to encode and decode information required for the production of structural protein

OBJECTIVE 12

1. a. sugars; saccharides
   b. monosaccharides
   c. ribose; deoxyribose
   d. oligosaccharides
   e. cellulose
   f. glycogen
   g. starches

2. a. carbon; hydrogen; phosphorus
   b. triglycerides
   c. phospholipids
   d. steroids
   e. prostaglandins

3. a. amino acids
   b. keratin; collagen; hemoglobin; myosin
   c. hormones
   d. antibodies
   e. enzymes

4. a. nucleotides
   b. deoxyribonucleic acid
   c. ribonucleic acid

OBJECTIVE 13

a. 20
b. Oxygen
c. Carbon; hydrogen
d. nitrogen; calcium; phosphorus
e. trace amounts

OBJECTIVE 14

a. A solution that has a higher concentration of dissolved particles than the solution to which it is compared

b. A solution that has a lower concentration of dissolved particles than the solution to which it is compared

c. A solution that has the same concentration of dissolved particles as the solution to which it is compared

OBJECTIVE 15

a. Fluid contained within the cells
b. Fluid between the cells and in special cavities, such as in the cranium
c. The fluid portion of blood

OBJECTIVE 16

A substance that forms ions when it dissolves

OBJECTIVE 17

Discussion should include the following points.

- Dissolved electrolytes have an excess or shortage of electrons, giving them a negative or a positive charge respectively.
- Body functions are most efficient when the concentrations of the electrolytes are within specific ranges.
- Electrolytes are lost through sweating and through the elimination of urine and feces.

OBJECTIVE 18

Discussion should include the following points.

- Acids and bases are classed as strong, using a value called *pH*, with the most-acidic substances having a value toward 0 and the most-basic substances having a value toward 14.
- Body fluids have a normal pH value with a narrow range above and below that value.
- If the pH value of a fluid goes above or below its ideal range, chemical reactions will be affected.
- Normal human activities can lead to major shifts in pH.
- To compensate for these potential changes in pH, the body contains buffer systems.
- Buffer systems contain a weak acid and a weak base that react with strong acids and strong bases to produce substances that do not change the normal pH excessively.

OBJECTIVE 19	The processes that lead to chemical reactions in the body
OBJECTIVE 20	a. adenosine triphosphate b. glucose; oxygen c. Energy d. enzymes e. cell division f. temperature
OBJECTIVE 21	a. 96.5; 99.5; 36; 38 b. 98.6; 37 c. lower d. hypothalamus e. constrict f. dilate g. sweating h. Fever i. Hypothermia
OBJECTIVE 22	a. The process by which organisms create more of their own kind b. The orderly increase in size that an organism exhibits as it matures c. The process by which organisms convert matter and energy to sustain life functions d. The ability to change the location of matter from one place to another e. The characteristic of an organism to react to changes in its environment f. The process of modifying life processes to improve an organism's chances of survival
OBJECTIVE 23	All organisms are made of small, enclosed bodies called *cells* and of the products of those cells.
OBJECTIVE 24	a. Serves as the solvent in all cell chemistry b. Forms the structural framework of protoplasm c. Serve as a source of energy during metabolism d. Store excess energy e. Control the growth and reproduction of cells f. Serve as chemical buffers to maintain the chemical balance in cells
OBJECTIVE 25	a. The protoplasm found outside the nucleus of a cell b. The protoplasm found in the nucleus of a cell

OBJECTIVE 26

a. Cilia
b. Golgi apparatus
c. Nucleus
d. Nucleolus
e. Vesicle
f. Mitochondrion
g. Cytoplasm
h. Cell membrane
i. Smooth endoplasmic reticulum
j. Ribosome
k. Lysosome
l. Rough endoplasmic reticulum
m. Centrosome
n. Microvilli

OBJECTIVE 27

a. 7
b. 6
c. 9
d. 5
e. 2
f. 4
g. 1
h. 3
i. 8

OBJECTIVE 28

a. One of several strands of DNA that contains the genetic code that determines inherited traits

b. A thickening of the outer surface of the nucleus protoplasm that regulates the movement of materials into and out of the nucleus

c. A dense spherical structure within the nucleus that is involved in protein synthesis and that forms ribosomal RNA

OBJECTIVE 29

a. Hair-like projections of the cells that form the mucous lining of the respiratory system and other passageways

b. A single hair-like projection on a sperm cell

c. Extensions of the cell cytoplasm that line the intestines

OBJECTIVE 30

a. Help to propel fluid in one direction over the surface of the cells
b. Helps to propel a sperm cell so that it can reach an ovum
c. Serve to increase the surface area of cells

OBJECTIVE 31

Answers should include any seven of the following. Answers may appear in any order.

- To absorb materials to support cell functions
- To metabolize nutrients
- To metabolize oxygen
- To release energy
- To synthesize protein
- To excrete waste products
- To reproduce itself
- To support functions specific to that kind of cell

OBJECTIVE 32 The movement of substances in and out of the cells

OBJECTIVE 33 a

OBJECTIVE 34

a. 2
b. 3
c. 1

OBJECTIVE 35

a. 2
b. 4
c. 1
d. 3

OBJECTIVE 36

a. cytoplasm; cell membrane
b. anabolism
c. amino acids
d. ribosome; transfer RNA (tRNA); messenger RNA (mRNA)
e. amino acids
f. enzyme
g. polypeptides
h. enzymes
i. enzymes; proteins
j. Mitochondria
k. DNA

OBJECTIVE 37 Descriptions should include the following points.

a. **Mitosis**

- Occurs in all human cells other than reproductive cells and nerve-tissue cells
- Gives rise to two daughter cells that are identical to the parent cell
- Consists of four distinct stages

b. **Meiosis**

- Occurs in reproductive cells
- Gives rise to four daughter cells that each contain only half the number of chromosomes found in the parent cell
- Consists of two stages

OBJECTIVE 38 Description should include the following points.

- Exposure to certain conditions can disrupt the genetic makeup of a cell, resulting in a mutation.

- A mutation may lead to structural or functional disorders that are then passed on to daughter cells during mitosis.

Objective 39

Answers may appear in any order.

a. Exposure to chemicals
b. Exposure to energy sources
c. Infections by other organisms

Objective 40

a. 1	d. 2	g. 2	j. 2	m. 2
b. 2	e. 1	h. 1	k. 3	n. 3
c. 3	f. 3	i. 1	l. 1	o. 1

Objective 41

a. 5	d. 4	g. 2
b. 7	e. 6	
c. 1	f. 3	

Objective 42

a. 6	d. 3
b. 2	e. 1
c. 5	f. 4

Objective 43

a. An invertebrate organism with six or more jointed legs and an exoskeleton

b. A widely distributed unicellular organism that may or may not cause disease

c. A unicellular or multicellular organism that reproduces by means of spores and that may be pathogenic or nonpathogenic

d. A unicellular organism that is adapted for life in water and forms cysts that pass from host to host

e. A subcellular organism that reproduces as a parasite within other organisms and, consequently, is pathogenic

f. A multicellular organism that in its parasitic form can be pathogenic to humans

Objective 44

a. Bacillum
b. Spirillum
c. Coccus

Objective 45

a. Organisms that normally live in and on the bodies of healthy persons without causing harm when located in specific sites

b. Organisms that take up residence in or on the body temporarily in a location where they are not normally found

OBJECTIVE 46

Description should include the following.

- A gram stain identifies the shape of a pathogen and indicates a positive or negative characteristic of the pathogen that allows preliminary identification of the organism as an aid to diagnosis.

OBJECTIVE 47

a. outer cell wall
b. Cocci; bacilli
c. binary fission
d. Aerobic
e. Anaerobic
f. Facultative anaerobic

OBJECTIVE 48

a. bacteria
b. arthropods
c. antibiotics

OBJECTIVE 49

a. protein
b. shape
c. reproduce
d. nucleic acid; enzymes
e. the type of cells that are infected
f. dormant; active
g. pregnant woman to her fetus
h. inside cells; reproduce; attacked

OBJECTIVE 50

a. unicellular
b. water; soil
c. cysts
d. food; water

OBJECTIVE 51

1. a. unicellular; multicellular
   b. body
   c. antibiotics; resistance
   d. superficial; spores

2. a. unicellular; multicellular
   b. Infestation, trauma, bursa
   c. skin lesions, laboratory analysis

OBJECTIVE 52

a. nutrients
b. eggs; larvae; adult
c. body sites
d. inhabited site; development
e. Mites; lice
f. vectors

Answers to Assignment Sheet

Assignment Sheet 1

Suggested answers

CASE STUDY 1

Salts are dissolved in the water to make the solution comparable to the concentration of blood plasma and body fluids. If the IV solutions were lower concentrations than the surrounding cells, then minerals, nutrients, and other chemicals would flow from the cells into the solution-diluted blood.

CASE STUDY 2

The pH will decrease in the blood. The increased CO_2 will result in more hydrogen ions in the blood, causing the blood to be more acidic.

CASE STUDY 3

While sports drinks can help to replace electrolytes, they can actually slow the absorption of fluid. Most fluid absorption occurs in the small intestine. If the fluid has a high solute concentration, absorption will be slower.

CASE STUDY 4

Calcium is the chemical. Inadequate intake of calcium leads to the body resorbing calcium from the bones to supply other systems with the required calcium. This process reduces bone mass.

CASE STUDY 5

Anemia can be caused by kidney or liver disorders or a low intake of dietary iron. Iron supplements may be prescribed.

CASE STUDY 6

Answers will vary and must be evaluated to the satisfaction of the instructor.

Optional Assignment Sheet 1—Complete an Overview of an Important Figure, Field of Study, or Theory of Biochemistry and Microbiology

Name ______________________________ Date ______________

Evaluation criteria **Rating**

- Report was prepared per instructor's requirements (length, typing, references, etc.) ______
- Information in the report is thorough and accurate ______
- Spelling, grammar, and punctuation are acceptable ______

Overall rating ______

Evaluator's comments ____

____

____

INTRODUCTION

As with any science, the knowledge gained through the studies of biochemistry and microbiology has been built upon year by year. Many people have contributed to what we know about these fields today. The understanding of how the body works and of how chemicals and other organisms affect it involve a lot of research to learn facts and to piece those facts together. Modern medicine owes a lot to those men and women who conducted that research, who offered theories, and who did the work to prove the theories right or wrong. There is still much that we do not know, but the ongoing research brings new discoveries everyday that add to our understanding of how we can live longer and healthier.

EXERCISE

ACTIVITY CHECKLIST

Put a checkmark on the blank line before each activity below and on the following page as you complete it.

______ 1. On the next page is a listing of a number of topics in three different areas: historical figures, fields of study, and historical theories. Discuss these topics with your instructor and select one on which you can do some research. List the topic of that research on the blank line provided on page 63.

______ 2. Use resources within or outside your facility, including the Internet, to research your topic. Complete resource notes, indicating your sources of information.

______ 3. Turn in your resource notes to your instructor for evaluation.

______ 4. Consult with your instructor to determine the format for your research presentation: a written or oral report, a poster, a video, a PowerPoint presentation, etc. List the format of the presenation on the blank line provided on page 63.

______ 5. Have your instructor work with you to determine the criteria by which your presentation will be evaluated. Describe that criteria on the blank lines on page 63.

Topics

A. **Historical figures**

1. Hippocrates
2. Vesalius
3. Galen
4. Semmelweis
5. Holmes
6. van Leeuwenhoek
7. Louis Pasteur
8. Joseph Lister
9. Robert Koch
10. Alexander Fleming
11. Jonas Salk

B. **Fields of study**

1. Basic microbiology
2. Medical
3. Agricultural
4. Sanitary
5. Industrial
6. Bacteriology
7. Protozoology
8. Parasitology
9. Helminthology
10. Virology

C. **Historical theories**

1. Identification of bacteria
2. Abiogenesis
3. Biogenesis
4. Germ theory of fermentation
5. Germ theory of disease
6. Koch's postulates

- On the blank line below, list the topic of your research.

  Topic ____________________

- On the blank line below, list the format of your presentation.

  Format of presentation ____________________

  ____

- On the blank lines below, describe the criteria selected for the evaluation of your presentation.

  ____

  ____

  ____

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  ____

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Answers to Optional Assignment Sheet

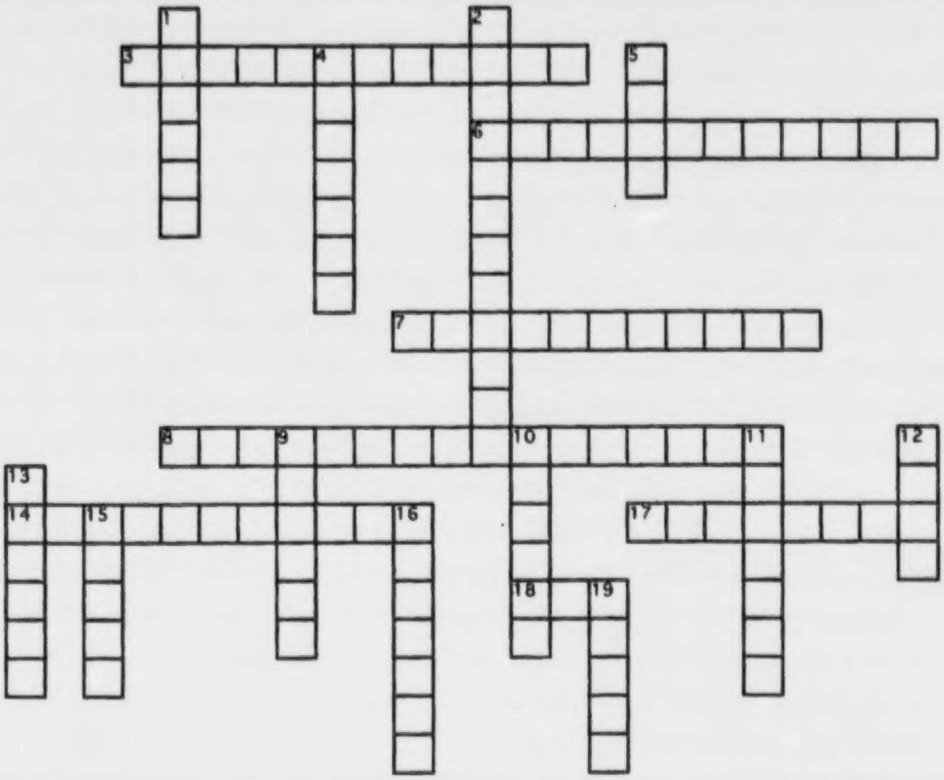
Optional Assignment Sheet 1

Topics and presentation formats will vary. The presentation must be evaluated to the satisfaction of the instructor.

Module Set I: Introduction to Anatomy and Physiology
Module 2: Biochemistry and Microbiology

Crossword Puzzle 1—Terms from Objectives 1 Through 6

Name ____ **Date** ________________



ACROSS

3. The study of chemistry as it relates to life
6. The study of extremely small life
7. The state of the body in which conditions remain relatively stable despite changes in the environment
8. A process in which one or more chemicals that are exposed to other chemicals or sources of energy such as heat change their chemical composition to produce other chemicals and often other forms of energy (2 words)
14. The physical and chemical processes by which an organism supplies its cells and tissues with oxygen and removes carbon dioxide
17. A negatively charged elementary particle of an atom
18. A state of matter in which the substance will take on the shape of any container in which it is placed and will expand to fill the container

DOWN

1. A state of matter in which the substance will take on the shape of a container but will not expand to fill a container with greater volume than the substance
2. The number of protons, or positive charges, in the nucleus of an atom of a particular element (2 words)
4. One of more than 100 primary, simple substances that cannot be broken down by chemical means into any other substance
5. The smallest division of an element that exhibits all the properties and characteristics of the element
9. That portion of the universe that has shape and substance
10. The capacity to do work
11. The structure in the center of an atom consisting of protons and neutrons and about which electrons orbit
12. The mechanism by which atoms link to one another to form molecules involving the loss of, gaining of, or sharing of electrons in the outer shell
13. A positively charged particle that is a fundamental component of the nucleus of atoms
15. The set of electron orbits in an atom that have the same energy level
16. An elementary particle that is a fundamental component of the nucleus of atoms; it has no electric charge
19. A state of matter in which the substance has a definite shape that is maintained unless acted upon by a force that is capable of changing that shape

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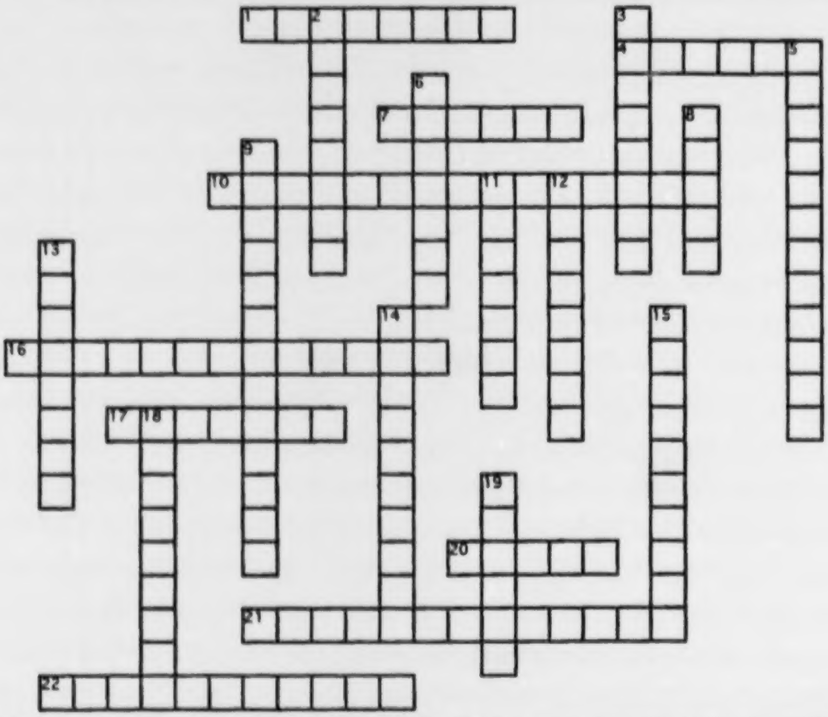
Crossword Puzzle 2—Terms from Objectives 7 Through 11

Name ______________________________ Date ______________



ACROSS

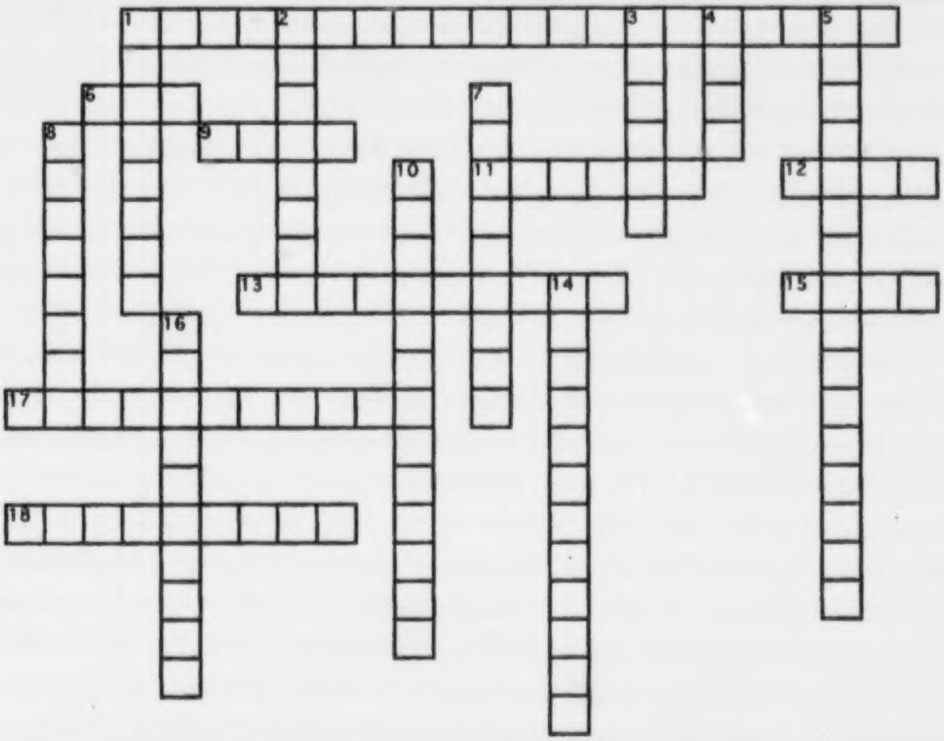
1. A substance that consists of atoms of two or more different elements bonded together as molecules; to separate its components into other compounds and elements requires a chemical reaction
4. A principal element or compound that is required for the chemical reaction that releases energy from nutrients; one of the atoms in a water molecule; a key element in other compounds of importance to the body
7. Organic compounds that serve as a means of storing energy, providing structure to cell membranes, and influencing some hormone functions
10. The concentration level of a solution above which no more of a substance will dissolve (2 words)
16. Organic compounds that serve as the major source of energy
17. A principal element or compound that serves as the primary energy source for the cells
20. An abnormally high body temperature
21. The ratio of the components of a solution or mixture
22. The sequence of bases in DNA that determines how the organism will be structured (2 words)

DOWN

2. A structure consisting of two or more atoms
3. A substance that consists of one or more components dissolved in a liquid; to separate its components, the energy of the substance must change so that the energy balance between the components prevents the liquid from being able to hold the dissolved material
5. Organic compounds that serve to encode and decode information required for the production of structural protein (2 words)
6. A substance that consists of two or more combined components that do not interact chemically; to separate its components requires either a mechanical method or the application of energy
8. A principal element or compound that dissolves substances to make them more usable to the body; provides fluid to lubricate moving parts of the body; helps to maintain body temperature
9. A principal element or compound that is given off as a waste product of cell respiration (2 words)
11. A compound that contains carbon and hydrogen
12. Organic compounds that serve many roles in the human body that can be generally classed as *functional*, in which it regulates a chemical reaction, or *structural*, in which it is a component in cells and tissues
13. A substance that affects the rate of change in a chemical reaction without being changed chemically
14. A device that is used to separate the components of a solution or liquid mixture by spinning the substance
15. The act of breathing out or exhaling
18. To improve the ease of movement between two objects by applying a substance that reduces friction
19. A statement that provides an explanation based on evidence without final proof being obtained

Crossword Puzzle 3—Terms from Objectives 12 Through 21

Name ______________________________ Date ______________



ACROSS

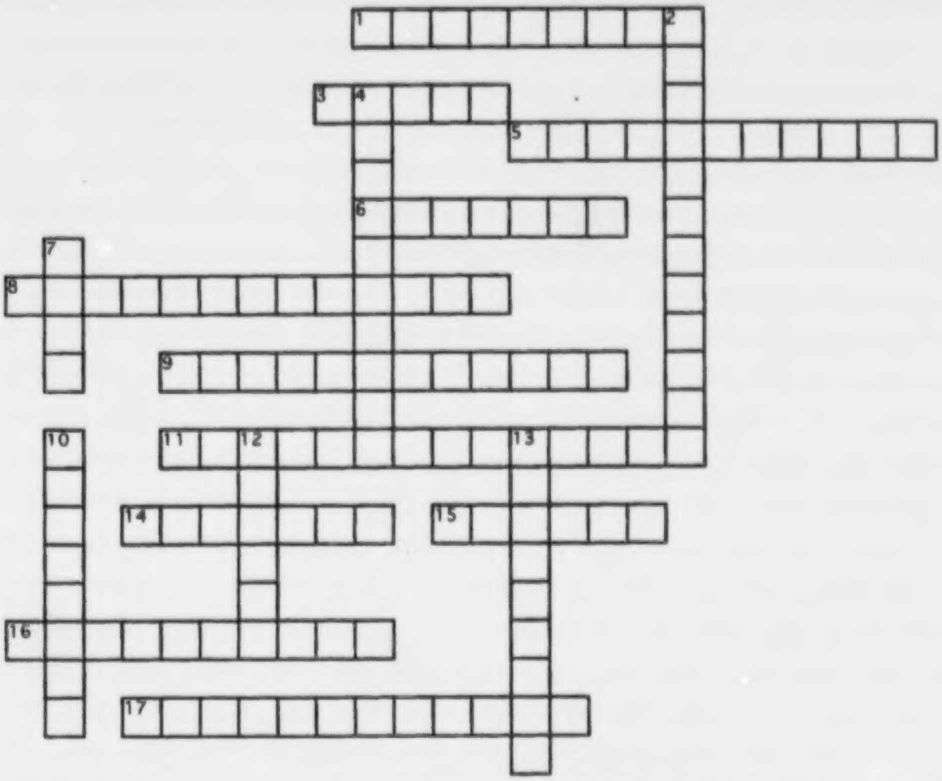
1. The way the body reacts to an injury (2 words)
6. An atom or group of atoms with either a positive or a negative electrical charge
9. A substance that releases a hydrogen ion when dissolved
11. The fluid portion of blood
12. A class of chemicals that have a positive ion other than hydrogen and a negative ion that is not a hydroxyl
13. A solution that has a higher concentration of dissolved particles than the solution to which it is compared
15. A substance that releases a hydroxide ion when dissolved
17. A substance that forms ions when it dissolves
18. The process of chemical synthesis in which smaller molecules are combined to produce larger molecules

DOWN

1. A solution that has the same concentration of dissolved particles as the solution to which it is compared
2. A protein molecule that will bind to foreign substances in the body
3. A protein that acts as a catalyst in a chemical reaction
4. An opening in a surface that allows materials to pass through
5. The process of developing secondary sexual characteristics and becoming able to reproduce (2 words)
7. A solution that has a lower concentration of dissolved particles than the solution to which it is compared
8. An anion consisting of one hydrogen atom and one oxygen atom
10. Fluid contained within the cells
14. Fluid between the cells and in special cavities, such as in the cranium
16. The process of reducing large molecules into smaller molecules

Crossword Puzzle 4—Terms from Objectives 22 Through 25

Name ____________________________________ Date ______________



ACROSS

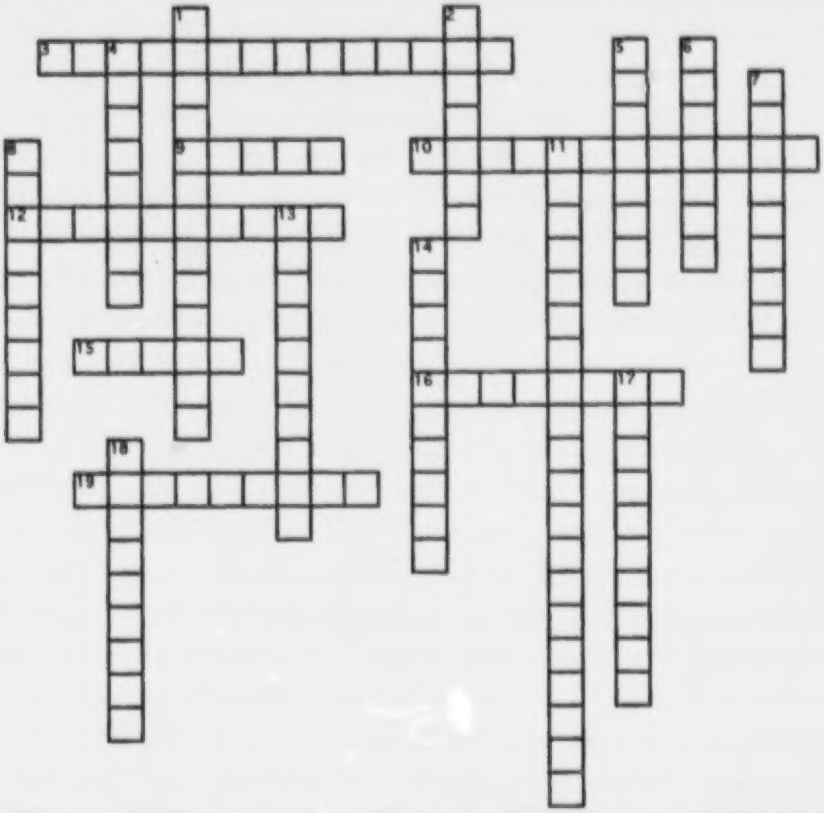
1. The protoplasm found outside the nucleus of a cell
3. The compound that serves as the solvent in all cell chemistry
5. The protoplasm found in the nucleus of a cell
6. The compound that forms the structural framework of protoplasm
8. The compounds that serve as a source of energy during metabolism
9. The compounds that control the growth and reproduction of cells (2 words)
11. The characteristic of an organism to react to changes in its environment
14. Relating to reproduction that does not involve the union of individual organisms or separate cells
15. The orderly increase in size that an organism exhibits as it matures
16. The process by which organisms convert matter and energy to sustain life functions
17. The process by which organisms create more of their own kind

DOWN

2. The compounds that serve as chemical buffers to maintain the chemical balance in cells (2 words)
4. The process of modifying life processes to improve an organism's chances of survival
7. The compounds that store excess energy
10. The ability to change the location of matter from one place to another
12. Relating to reproduction that requires a union of two organisms or the union of separate cells
13. The theory that proposes that all life began as simple organic compounds that over time developed the characteristics of life and continued to become more complex in functioning and in coping with the environment; the Theory of ______

Crossword Puzzle 5—Terms from Objectives 26 Through 30

Name ______________________________ Date ____________



ACROSS

3. Part of a cell that synthesizes carbohydrates and packages materials to prepare them for secretion from the cell (2 words)
9. Hair-like projections of the cells that form the mucous lining of the respiratory system and other passageways
10. The characteristic of a material to allow other substances to pass through it
12. One of several strands of DNA that contains the genetic code that determines inherited traits
15. Specialized structures that help to propel fluid in one direction over the surface of cells
16. Part of a cell that synthesizes protein
19. A single hair-like projection on a sperm cell

DOWN

1. Part of a cell that produces ATP and serves as the site of cell respiration
2. Part of a cell that regulates cellular structure and activities, including reproduction of the cell
4. Part of a cell that contains the enzymes used to digest ingested material and damaged tissue
5. Part of a cell that allows some molecules to enter the cell while preventing entry by other molecules
6. The thick membrane of the outer surface of the nucleus protoplasm that regulates the movement of materials into and out of the nucleus
7. Part of a cell that provides structure to the cell and supports other parts of the cell
8. A dense spherical structure within the nucleus that is involved in protein synthesis and that forms ribosomal RNA
11. Part of a cell that provides a passageway for the transport of materials within the cell and synthesizes lipids (2 words)
13. Extensions of the cell cytoplasm that line the intestines
14. Part of a cell that organizes special spindle fibers during cell division
17. Specialized structures that serve to increase the surface area of cells
18. Specialized structure that helps to propel a sperm cell so that it can reach an ovum

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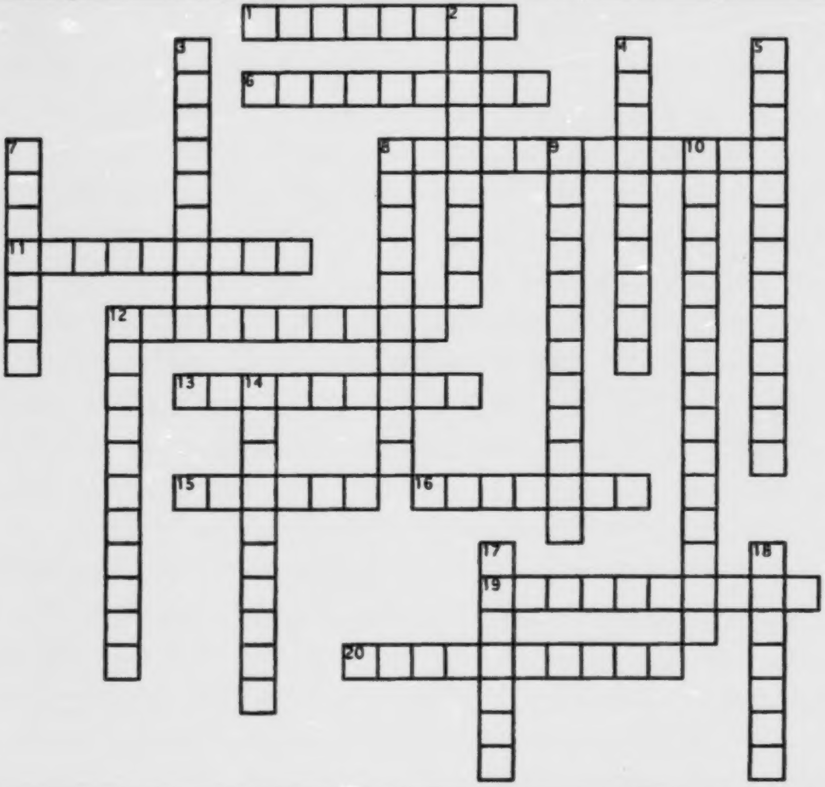
Crossword Puzzle 6—Terms from Objectives 31 Through 42

Name ______________________________ **Date** ______________



ACROSS

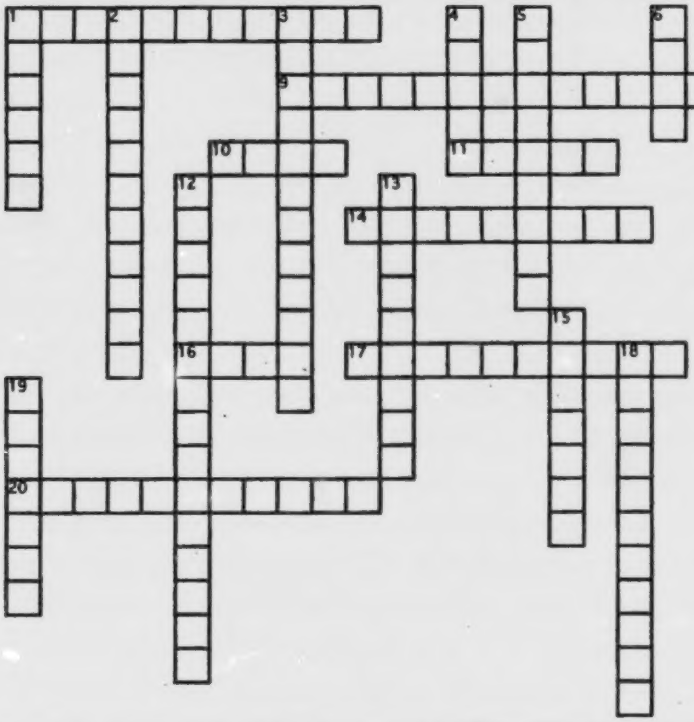
1. The ______ transport system is a type of cellular respiration that combines hydrogen and oxygen released from other forms of respiration to produce water
6. A relationship between two organisms that is beneficial to both
8. The process of a cell engulfing a solid particle with a portion of its membrane, which then breaks off from the membrane and migrates into the cell as a closed vesicle
11. A relationship between two organisms that have close contact with each other
12. A relationship between two organisms in which one organism is capable of causing a disease in the other organism
13. The process by which particles in a fluid spread throughout the fluid to produce an equal concentration
15. Type of transport where movement requires the use of energy for the cell to transport the material through the cell wall
16. The process by which solvent molecules pass through a semipermeable membrane to produce an equal concentration on each side of the membrane
19. The process of a cell carrying substances in vesicles and secreting through the cell membrane
20. A type of cellular respiration that does not require oxygen

DOWN

2. Aerobic ______ is a type of cell respiration that uses enzymes located in the mitochondria
3. The movement of substances in and out of the cells
4. A relationship between two organisms in which the organisms present no significant benefit or harm to each other
5. Type of pump that moves molecules or ions through cell membranes against the pressure of natural forces
7. Type of transport where movement occurs without any energy being expended by the cell
8. A relationship between two organisms in which one organism is harmed by the presence of the other
9. A relationship between two organisms in which one organism benefits and the other neither benefits nor is harmed
10. To produce a copy of oneself
12. The process of a cell engulfing a liquid particle with a portion of its membrane, which then breaks off from the membrane and migrates into the cell as a closed vesicle
14. The process by which solvents or specific particles are able to move through a membrane that prevents the passage of other solvents or particles
17. Type of cellular reproduction that occurs in reproductive cells
18. Type of cellular reproduction that occurs in all human cells other than reproductive cells and nerve-tissue cells

Crossword Puzzle 7—Terms from Objectives 43 Through 52

Name ______________________________ Date ______________



ACROSS

1. Having the ability to adapt to more than one condition
9. The conditions that tend to promote the spread of a disease, such as when the bite of an arthropod allows pathogens to enter a person's bloodstream (3 words)
10. A multicellular organism that in its parasitic form can be pathogenic to humans
11. The dormant form of a bacterium or the reproductive form of a fungus
14. An invertebrate organism with six or more jointed legs and an exoskeleton
16. A capsule that forms around microorganisms before they enter dormant periods
17. A condition of diarrhea caused by drinking water containing giardia
20. A characteristic of some organisms in which the outer tissue of parts of the body are hardened to the point that they support attached softer tissues

DOWN

1. A unicellular or multicellular organism that reproduces by means of spores and that may be pathogenic or nonpathogenic
2. Consisting of one cell
3. An organism that does not have an internal skeleton and, specifically, a spinal column
4. A subcellular organism that reproduces as a parasite within other organisms and, consequently, is pathogenic
5. A unicellular organism that is adapted for life in water and forms cysts that pass from host to host
6. The organism that provides the resources required to sustain a parasitic relationship
7. A widely distributed unicellular organism that may or may not cause disease
8. Organisms that normally live in and on the bodies of healthy persons without causing harm when located in specific sites are called ______ flora
12. A condition of severe diarrhea often accompanied by blood and mucus that results from an infection of protozoa (2 words)
13. Organisms that take up residence in or on the body temporarily in a location where they are not normally found are called ______ flora
15. A parasitic infection of red blood cells by plasmodium virus transmitted by the bite of certain species of mosquito
18. The presence of parasites in the environment, on the skin, or in the hair of a host
19. A condition of being highly sensitive to foreign substances that enter the body often because the person's immune system does not respond to the antigen of the substance

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Answers to Crossword Puzzles

Crossword Puzzle 1

ACROSS

3. BIOCHEMISTRY
6. MICROBIOLOGY
7. HOMEOSTASIS
8. CHEMICAL REACTION
14. RESPIRATION
17. ELECTRON
18. GAS

DOWN

1. LIQUID
2. ATOMIC NUMBER
4. ELEMENT
5. ATOM
9. MATTER
10. ENERGY
11. NUCLEUS
12. BOND
13. PROTON
15. SHELL
16. NEUTRON
19. SOLID

Crossword Puzzle 2

ACROSS

1. COMPOUND
4. OXYGEN
7. LIPIDS
10. SATURATION POINT
16. CARBOHYDRATES
17. GLUCOSE
20. FEVER
21. CONCENTRATION
22. GENETIC CODE

DOWN

2. MOLECULE
3. SOLUTION
5. NUCLEIC ACIDS
6. MIXTURE
8. WATER
9. CARBON DIOXIDE
11. ORGANIC
12. PROTEINS
13. CATALYST
14. CENTRIFUGE
15. EXHALATION
18. LUBRICATE
19. THEORY

Crossword Puzzle 3

ACROSS

1. INFLAMMATORY RESPONSE
6. ION
9. ACID
11. PLASMA
12. SALT
13. HYPERTONIC
15. BASE
17. ELECTROLYTE
18. ANABOLISM

DOWN

1. ISOTONIC
2. ANTIBODY
3. ENZYME
4. PORE
5. SEXUAL MATURATION
7. HYPOTONIC
8. HYDROXYL
10. INTRACELLULAR
14. INTERSTITIAL
16. CATABOLISM

Crossword Puzzle 4

ACROSS
1. CYTOPLASM
3. WATER
5. NUCLEOPLASM
6. PROTEIN
8. CARBOHYDRATES
9. NUCLEIC ACIDS
11. RESPONSIVENESS
14. ASEXUAL
15. GROWTH
16. METABOLISM
17. REPRODUCTION

DOWN
2. MINERAL SALTS
4. ADAPTATION
7. FATS
10. MOVEMENT
12. SEXUAL
13. EVOLUTION

Crossword Puzzle 5

ACROSS
3. GOLGI APPARATUS
9. CILIA
10. PERMEABILITY
12. CHROMOSOME
15. CILIA
16. RIBOSOME
19. FLAGELLUM

DOWN
1. MITOCHONDRION
2. NUCLEUS
4. LYSOSOME
5. MEMBRANE
6. NUCLEAR
7. CYTOPLASM
8. NUCLEOLUS
11. ENDOPLASMIC RETICULUM
13. MICROVILLI
14. CENTROSOME
17. MICROVILLI
18. FLAGELLUM

Crossword Puzzle 6

ACROSS
1. ELECTRON
6. MUTUALISM
8. PHAGOCYTOSIS
11. SYMBIOSIS
12. PATHOGENIC
13. DIFFUSION
15. ACTIVE
16. OSMOSIS
19. EXOCYTOSIS
20. GLYCOLYSIS

DOWN
2. OXIDATION
3. TRANSPORT
4. NEUTRALISM
5. PHYSIOLOGICAL
7. PASSIVE
8. PARASITISM
9. COMMENSALISM
10. SELF REPLICATION
12. PINOCYTOSIS
14. FILTRATION
17. MEIOSIS
18. MITOSIS

Crossword Puzzle 7

ACROSS

1. FACULTATIVE
9. VECTORS OF DISEASE
10. WORM
11. SPORE
14. ARTHROPOD
16. CYST
17. GIARDIASIS
20. EXOSKELETON

DOWN

1. FUNGUS
2. UNICELLULAR
3. INVERTEBRATE
4. VIRUS
5. PROTOZOAN
6. HOST
7. BACTERIUM
8. RESIDENT
12. AMEBIC DYSENTERY
13. TRANSIENT
15. MALARIA
18. INFESTATION
19. ALLERGY

Module Review

Name ______________________________

Date ____________________ Score ____________________

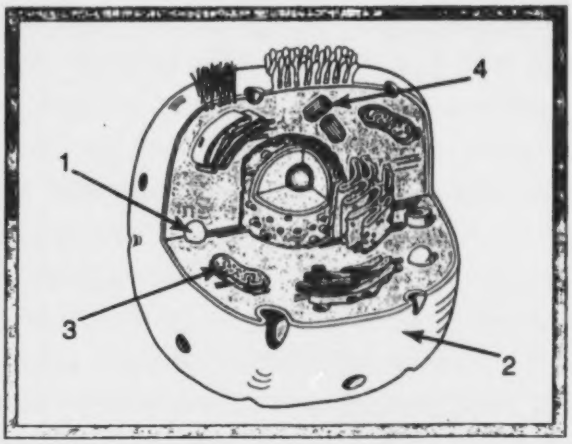
DIRECTIONS Read each of the items below. From the choices given, select the response that most-correctly provides the required information. Circle the letter of the most-correct response.

Objective 20

1. Which of the following is NOT a correct statement about the use of energy by the body?
    - a. Energy is stored in the hydrogen bonds of ATP until it is needed for cell functions.
    - b. All cells contain enzymes that allow them to break the phosphate bonds in ATP.
    - c. Energy released from ATP fuels cell functions, including cell division to produce new cells.
    - d. Some of the energy is applied to moving substances in and out of the cell and in carrying out chemical reactions, as well as providing the cell with a stable temperature.

Objective 26

2. In the illustration below, which of the following is NOT a correct match of number and the part indicated?
    - a. 1, nucleus
    - b. 2, cell membrane
    - c. 3, mitochondrion
    - d. 4, centrosome



Objective 47

3. Bacteria reproduce by binary fission, in which the ______ duplicates itself and then the cell divides into two identical cells.

   a. chromosome

   b. nucleus

   c. mitochrondrion

   d. cytoplasm

Objective 49

4. Which of the following statements is NOT true with regard to characteristics of viruses?

   a. Viruses can only reproduce when they are within the living cells of a host organism.

   b. A virus will use the nucleic acid and enzymes of an infected cell to produce other viruses, often multiplying to the point that the cell ruptures and dies.

   c. Some viruses can become dormant so that they present no signs of infection and then become active again after a period of time, even years later.

   d. The amniotic barrier prevents viruses from being transmitted from a pregnant woman to her fetus.

Objective 2

5. ______ is a state of matter in which the substance will take on the shape of a container but will not expand to fill a container with greater volume than the substance.

   a. Energy

   b. A solid

   c. A liquid

   d. A gas

Objective 2

6. Which of the following is NOT a correct statement about the role of chemistry in human health?

   a. The body consists of various chemicals.

   b. Most body activities involve chemical reactions.

   c. For a person to remain healthy, the chemicals within the body must remain properly balanced.

   d. The body's defense systems prevent chemicals outside the body from entering.

Objective 5

7. An atom is the smallest division of ______ that exhibits all of its properties and characteristics.

   a. a molecule
   b. an element
   c. a nucleus
   d. a substance

Objective 8

8. The level of a solution above which no more of a substance will dissolve in the liquid is its ______ point.

   a. concentration
   b. catalyst
   c. saturation
   d. centrifuge

Objective 8

9. A ______ is a substance that consists of one or more components dissolved in a liquid.

   a. mixture
   b. compound
   c. solution
   d. element

Objective 9

10. ______ serves as the primary energy source for the cells.

   a. Oxygen
   b. Glucose
   c. Water
   d. Sodium chloride

Objective 11

11. Which of the following phrases describes a primary function of carbohydrates in the body?

   a. serve as a means of storing energy, providing structure to cell membranes, and influencing some hormone functions
   b. serve many roles in the human body that can be generally classed as *functional* or *structural*
   c. serve as the major source of energy for the body
   d. serve to encode and decode information required for the production of structural protein

Objective 12

12. Nucleic acids are made of ______.

    a. nucleoli

    b. nucleotides

    c. pyruvic acids

    d. ribosomal acids

Objective 13

13. What is the most-plentiful element in the human body by weight?

    a. hydrogen

    b. oxygen

    c. carbon

    d. water

Objective 16

14. Substances that form ions when they dissolve are called ______.

    a. electrolytes

    b. analytes

    c. electrolysis

    d. solvents

Objective 17

15. Dissolved electrolytes with a shortage of electrons have a ______ charge.

    a. base

    b. acid

    c. positive

    d. negative

Objective 17

16. Which of the following statements is NOT true about electrolytes?

    a. Dissolved electrolytes with an excess of electrons have a negative charge.

    b. Body functions are most efficient when the concentrations of the electrolytes are within specific ranges.

    c. Electrolytes are lost through sweating and through the elimination of urine and feces.

    d. Electrolytes are stored between the skin and muscle for use when required.

Objective 21

17. ______ is an abnormally high body temperature.

   a. Fever
   b. Hypothermia
   c. Centigrade
   d. Edema

Objective 24

18. ______ control the growth and reproduction of cells.

   a. Carbohydrates
   b. Mineral salts
   c. Nucleic acids
   d. Fats

Objective 27

19. The ______ provides structure to the cell and supports other parts of the cell.

   a. ribosome
   b. centrosome
   c. cytoplasm
   d. cell nucleus

Objective 36

20. Which of the following is NOT a true statement about cell growth?

   a. To create the polypeptide chains, a ribosome attaches to a complementary set of RNA molecules—a transfer RNA (tRNA) molecule and a messenger RNA (mRNA) strand—and holds them together during protein synthesis.
   b. The ribosome moves along the RNA strand pair building polypeptides.
   c. Mitochondria increase by self-replication.
   d. During protein synthesis, nucleotides are bonded in polypeptide chains.

Objective 37

21. Which of the following phrases is NOT true about mitosis?

   a. occurs in all human cells other than reproductive cells and nerve-tissue cells
   b. consists of two stages
   c. gives rise to two daughter cells that are identical to the parent cell
   d. consists of four distinct stages

Objective 40

22. One cycle of the electron transport system produces ______ ATP molecules.

    a. 3

    b. 4

    c. 34

    d. 304

Objective 43

23. ______ is a parasitic infection of red blood cells by plasmodium virus transmitted by the bite of certain species of mosquito.

    a. Cyst

    b. Amebic dysentery

    c. Giardiasis

    d. Malaria

Objective 44

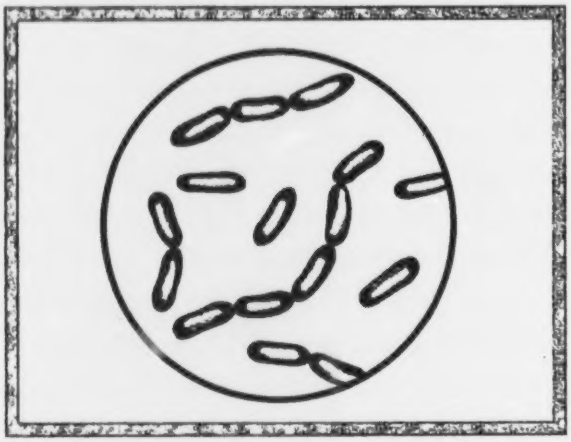
24. What type of bacteria is shown in the illustration below?

    a. bacillum

    b. coccus

    c. spirillum

    d. flagellum



Objective 47

25. The ______ gives a bacterium its shape.

    a. tough outer cell wall
    b. nucleus
    c. mitochondria
    d. tough inner cytoplasm

Objective 51

26. Which of the following phrases is NOT true with regard to fungi?

    a. may be unicellular or multicellular
    b. some are normally found in and on the body
    c. can form cysts and become dormant
    d. can spread to the inside of the body through spores

Objective 52

27. Mites and lice generally afflict the ______ of a host's body and present little direct risk to the host.

    a. surface
    b. viscera
    c. organs
    d. bloodstream

Objective 2

28. Injuries and diseases can change the ______ and can disrupt chemical reactions.

    a. chemical balance within the body
    b. overall chemical composition of the body
    c. electrical charge of all the ions in the body
    d. anions into cations

Objective 3

29. The state of the body in which conditions remain relatively stable despite changes in the environment is called ______.

    a. equilibrium
    b. chemical balance
    c. homeostasis
    d. hemostatic

Objective 7

30. A structure consisting of two or more atoms is a ______.

   a. gas

   b. solid

   c. liquid

   d. molecule

Objective 8

31. To separate the substances in a solution, the ______ of the solution must change so that the ______ balance between the components prevents the liquid from being able to hold the dissolved material.

   a. energy, energy

   b. energy, chemical

   c. chemistry, energy

   d. chemistry, chemical

Objective 10

32. A reaction that causes atoms or molecules to bond, thus producing different chemicals, is called a ______ reaction.

   a. synthesis

   b. decomposition

   c. chemical

   d. positive

Objective 10

33. Which of the following statements is NOT true with regard to chemical reactions and the body?

   a. Synthesis reactions are necessary to allow the body to build proteins and other building blocks of cells and tissue.

   b. Decomposition reactions are necessary to allow the body to break down the large, complex molecules of nutrients into small, easily transported molecules that the cells can use to sustain life.

   c. Catalysts or energy can be added to a chemical reaction to increase the rate of reaction.

   d. The failure to provide the reactive chemicals in the proper proportions and the failure to provide a required catalyst or energy source is overcome by the body's immune system.

Objective 12

34. Which of the following is NOT normally a part of a lipid compound?

a. carbon

b. nitrogen

c. hydrogen

d. phosphorus

Objective 13

35. In the human body, there are trace amounts—less than ______ percent—of a number of minerals, including manganese, iron, cobalt, copper, zinc, and others, as well as iodine and chlorine.

a. 0.1

b. 1

c. 10

d. 100

Objective 14

36. Which type of solution has a higher concentration of dissolved particles than the solution to which it is compared?

a. isotonic

b. hypertonic

c. hypotonic

d. supertonic

Objective 18

37. Acids and bases are classed as strong, using a value called *pH*, with the most-acidic substances having a value toward ______ and the most-basic substances having a value toward ______.

a. 14, 0

b. 0, 14

c. 1, 10

d. 10, 1

Objective 20

38. During cell metabolism in which ______ are converted into carbon dioxide and water, some of the energy released creates a bond between ADP and a phosphate group to produce ATP.

a. glycogen and oxygen

b. glucose and oxygen

c. glycogen and hydrogen

d. glucose and hydrogen

Objective 21

39. Normal body temperature ranges from ______.

a. 93.5° F to 96.5° F (33° C to 35° C)

b. 96.5° F to 99.5° F (36° C to 38° C)

c. 33° F to 35° F (36° C to 38° C)

d. 36° F to 35° F (36° C to 38° C)

Objective 25

40. The protoplasm found outside the nucleus of a cell is ______.

a. nucleoplasm

b. cytoplasm

c. endoplasm

d. exoplasm

Objectives 29 & 30

41. Which of the following phrases correctly describes a flagellum?

a. a single hair-like projection on a sperm cell that helps to propel the sperm cell so that it can reach an ovum

b. an extension of the cell cytoplasm that lines the intestines and serves to increase the surface area of cells

c. a single hair-like projection used to signal other cells about the presence of a pathogen

d. a hair-like projection of the cells that form the mucous lining of the respiratory system and other passageways and helps to propel fluid in one direction over the surface of cells

Objectives 32 & 33

42. The movement of substances in and out of cells is called *transport*; ______ transport is a type of transport that requires the use of energy for the cell to transport the material through the cell wall.

a. passive

b. active

c. dynamic

d. osmotic

Objectives 39 & 52

43. Which of the following is least likely to cause a change in the genetic makeup of cells?

a. exposure to energy sources such as ultraviolet light or radiation

b. exposure to a chemical such as asbestos

c. infections by other organisms

d. infestations of vector organisms

Objective 40

44. ______ converts pyruvic acid into one ATP molecule, hydrogen, carbon dioxide, and carbon molecules.

  a. Aerobic oxidation
  b. Anaerobic oxidation
  c. The electron transport system
  d. The nitrogen cycle

Objective 43

45. A unicellular organism that is adapted for life in water and forms cysts that pass from host to host is a ______.

  a. bacterium
  b. virus
  c. protozoan
  d. fungus

Objective 45

46. The organisms that take up residence in or on the body temporarily in a location where they are not normally found are called ______ flora.

  a. resident
  b. transient
  c. permanent
  d. independent

Objective 48

47. ______ are bacteria that can reproduce only within the cells of a living host.

  a. Algae
  b. Viruses
  c. Fungi
  d. Rickettsiae

Objective 50

48. Which of the following phrases is NOT true with regard to the characteristics of protozoa?

  a. are unicellular
  b. live in water and soil
  c. result from the use of antibiotics or reduced resistance due to injuries or diseases
  d. generally spread from food or water contaminated with cysts

Objective 52 49. Parasites such as lice, fleas, mosquitoes, and ticks may be ______ disease.

a. victims of
b. vectors of
c. immune to
d. invisible to

Objective 1 50. ______ is the study of extremely small life.

a. Matter
b. Energy
c. Biochemistry
d. Microbiology

Objective 6 51. The center part of an atom consists of ______.

a. protons and electrons
b. protons and neutrons
c. electrons and neutrons
d. protons and nuclei

Objective 8 52. A mixture consists of two or more combined substances that do not interact ______.

a. chemically
b. easily
c. electrically
d. physically

Objective 9 53. What compound is given off as a waste product of cell respiration?

a. carbon dioxide
b. carbon monoxide
c. oxygen
d. nitrogen

Objective 9

54. Which of the following is NOT a normal role of water in the body?

a. dissolves substances to make them more usable to the body
b. provides fluid to lubricate moving parts of the body
c. helps to maintain body temperature
d. combines with carbon to make carbohydrates

Objective 12

55. Which of the following is NOT a carbohydrate?

a. saccharides
b. nucleic acid
c. cellulose
d. glycogen

Objective 12

56. ______ store energy primarily in the form of body fat.

a. Phospholipids
b. Triglycerides
c. Steroids
d. Prostaglandins

Objective 13

57. Approximately how many elements are in the human body?

a. 5
b. 20
c. 50
d. 200

Objective 15

58. Cells contain fluid called ______ fluid.

a. intracellular
b. interstitial
c. tissue
d. plasma

Objective 19

59. ______ is the processes that lead to chemical reactions in the body.

    a. Metabolism

    b. Catabolism

    c. Anabolism

    d. Commecialism

Objective 20

60. The primary source of energy in the body is ______.

    a. adrenal triglyceride

    b. adipose tetraphosphate

    c. adenosine triphosphate

    d. ammonia tripotassium

Objective 23

61. Which of the following is the correct statement of the cell theory?

    a. All organisms are made of small, enclosed bodies called *cells* and of the products of those cells.

    b. All animals are made of small, enclosed bodies called *cells* and of the products of those cells.

    c. Cells can neither be created nor destroyed.

    d. All organisms started as simple cells and evolved into organisms with many cells.

Objective 24

62. What is the role of proteins in a cell?

    a. serve as the solvent in all cell chemistry

    b. form the structural framework of protoplasm

    c. serve as a source of energy during metabolism

    d. store excess energy

Objective 28

63. A chromosome is ______.

    a. a thickening of the outer surface of the nucleus protoplasm that regulates the movement of materials into and out of the nucleus

    b. a dense spherical structure within the nucleus that is involved in protein synthesis and that forms ribosomal RNA

    c. one of several strands of DNA that contains the genetic code that determines inherited traits

    d. a bubble-like vesicle used to move substances about the cell

Objective 35

64. Which of the following is NOT a type of active transport?

    a. phagocytosis

    b. physicocytosis

    c. pinocytosis

    d. exocytosis

Objective 37

65. ______ is the special kind of cell division involving reproductive cells.

    a. Mitosis

    b. Metabolism

    c. Meiosis

    d. Mycosis

Objective 41

66. Which of the following is the correct order of the taxonomy system used to classify organisms?

    a. kingdom, phylum, family, order, class, genus, species

    b. kingdom, phylum, class, order, family, genus, species

    c. kingdom, family, phylum, order, class, genus, species

    d. kingdom, family, phylum, class, order, genus, species

Objective 42

67. An organism that is capable of causing a disease in another organism is referred to as ______.

    a. *parasitic*

    b. *nonparasitic*

    c. *pathogenic*

    d. *nonpathogenic*

Objective 46

68. The ______ stain identifies the shape of a pathogen and indicates a positive or negative characteristic of the pathogen that allows preliminary identification of the organism as an aid to diagnosis.

    a. slide

    b. nash

    c. ounce

    d. gram

Objective 49

69. ______ are nucleic acids within shells of protein.
    a. Algae
    b. Viruses
    c. Fungi
    d. Rickettsiae

Objective 52

70. Which of the following statements is NOT true with regard to parasitic worms?
    a. Parasitic worms live off nutrients in the host's body or blood or on the host itself.
    b. Many parasitic worms have several stages of life involving eggs, larvae, and adult stages.
    c. Parasitic worms seldom inhabit specific body sites.
    d. For some species of parasitic worms, the inhabited site varies with the stage of development and may even involve more than one host species.

Objective 2

71. The body ______ special chemicals that regulate body functions.
    a. does not need
    b. uses nerve signals instead of
    c. produces
    d. normally needs medication to produce

Objective 4

72. An element is one of more than ______ primary, simple substances that cannot be broken down by chemical means into any other substance.
    a. 10
    b. 100
    c. 1,000
    d. 10,000

Objective 8

73. What is required to separate the substances in a mixture?
    a. a chemical reaction
    b. a change in ionization
    c. the addition of a third chemical
    d. a mechanical method or energy

Objective 8

74. A ______ is a substance that affects the rate of change in a chemical reaction without being changed chemically.

   a. compound

   b. catalyst

   c. mixture

   d. solution

Objective 10

75. A chemical reaction involves an interaction between two or more chemicals that results in matter with ______ the chemicals that were originally introduced into the reaction.

   a. a smaller atomic number than

   b. a larger atomic number than

   c. a different chemical composition from

   d. an identical chemical composition to

Objective 12

76. ______ serve as antigens on the outer surface of cell membranes.

   a. Oligosaccharides

   b. Starches

   c. Deoxyribose

   d. Monosaccharides

Objective 12

77. Proteins are made of ______.

   a. nucleic acids

   b. amino acids

   c. antibodies

   d. enzymes

Objective 12

78. ______ is a double strand of nucleotides with a structure that defines the code of inherited traits.

   a. DNA

   b. RNA

   c. NDA

   d. NRA

Objective 16

79. A base is a substance that releases a ______ ion when dissolved.

a. hydrogen

b. hydroxide

c. oxygen

d. oxide

Objective 18

80. Which of the following statements is NOT true about pH in the human body?

a. Body fluids have a normal pH value with a narrow range above and below that value.

b. If the pH value of a fluid goes above or below its ideal range, chemical reactions will be affected.

c. Normal human activities can lead to major shifts in pH.

d. Hydrogen additive systems contain a weak acid and a weak base that react with strong acids and strong bases to produce substances that do not change the normal pH excessively.

Objective 22

81. Which of the following pairs are NOT characteristics of living organisms?

a. reproduction and growth

b. metabolism and movement

c. adaptation and responsiveness

d. sleeping and excitability

Objective 27

82. The ______ is the part of a cell that provides a passageway for the transport of materials within the cell and synthesizes lipids.

a. endoplasmic reticulum

b. ribosome

c. Golgi apparatus

d. lysosome

Objective 34

83. The process by which particles in a fluid spread throughout the fluid to produce an equal concentration is ______.

a. diffusion

b. transfusion

c. filtration

d. osmosis

Objective 38

84. Exposure to certain conditions can disrupt the genetic makeup of a cell, resulting in a ______.

   a. mutagen
   b. chemical reaction
   c. daughter cell
   d. mutation

Objective 40

85. Aerobic oxidation uses ______.

   a. enzymes located in the mitochondria
   b. proteins located in the mitochondria
   c. enzymes located in the cytoplasm
   d. proteins located in the cytoplasm

Objective 43

86. A ______ is a multicellular or unicellular organism that reproduces by means of spores and that may be pathogenic or nonpathogenic.

   a. worm
   b. fungus
   c. virus
   d. arthropod

Objective 47

87. ______ often colonize with each other so that another way of identifying them is by the shape of their colonies.

   a. Cocci and spirilli
   b. Bacilli and spirilli
   c. Cocci and bacilli
   d. Spirilli and flagelli

Objective 5

88. "The smallest division of an element that exhibits all the properties and characteristics of the element" is the definition of which of the following terms?

   a. electron
   b. proton
   c. neutron
   d. atom

Objective 8

89. The separation of a compound into other compounds and elements requires a ______.

a. mechanical force
b. positive and a negative ion
c. chemical reaction
d. solvent

Objective 9

90. Which of the following phrases is true about the role of oxygen in the health of the body?

a. required for the chemical reaction that releases energy from nutrients
b. one of the atoms in a water molecule
c. a key element in compounds of importance to the body other than water
d. all of the above

Objective 9

91. An organic compound is one that contains ______.

a. hydrogen and oxygen
b. hydrogen, oxygen, and carbon
c. carbon and oxygen
d. carbon and hydrogen

Objective 12

92. Which of the following is NOT a structural protein?

a. prostaglandin
b. collagen
c. keratin
d. hemoglobin

Objective 13

93. The human body contains minor quantities of ______, calcium, and phosphorus.

a. helium
b. uranium
c. nitrogen
d. cadmium

Objective 16

94. An acid is a substance that releases a ______ ion when dissolved.

    a. hydrogen

    b. hydroxide

    c. oxygen

    d. oxide

Objective 19

95. "The process of chemical synthesis in which smaller molecules are combined to produce larger molecules" is the definition of ______.

    a. catabolism

    b. metabolism

    c. anabolism

    d. evolution

Objective 21

96. Which of the following is NOT a true statement about body temperature?

    a. Normal body temperature is considered to be 98.6° F (37° C).

    b. Body temperature is normally lower during sleep.

    c. Body temperature is regulated by the hypothalamus.

    d. Blood vessels near the surface of the skin dilate to reduce heat loss.

Objective 27

97. The ______ is the part of a cell that produces ATP and serves as the site of cell respiration.

    a. endoplasmic reticulum

    b. centrosome

    c. mitochondrion

    d. lysome

Objective 31

98. Which of the following phrases does NOT describe a cell function?

    a. to absorb materials to support cell functions and to release energy

    b. to metabolize nutrients and nitrogen

    c. to synthesize protein and to reproduce itself

    d. to excrete waste products and to support functions specific to that kind of cell

Objective 40

99. Which of the following phrases is NOT true about glycolysis?

a. uses enzymes located in the cytoplasm

b. requires oxygen

c. converts glucose and two ATP molecules into four ATP molecules, hydrogen, and energy

d. requires the vitamin niacin

Objective 42

100. A relationship between two organisms that is beneficial to both is called ______.

a. commensalism

b. parasitism

c. neutralism

d. mutualism

Answers to Module Review

1. a
2. a
3. a
4. d
5. c
6. d
7. b
8. c
9. c
10. b
11. c
12. b
13. b
14. a
15. c
16. d
17. a
18. c
19. c
20. d
21. b
22. c
23. d
24. a
25. a
26. c
27. a
28. a
29. c
30. d
31. a
32. a
33. d
34. b
35. a
36. b
37. b
38. b
39. b
40. b
41. a
42. b
43. d
44. a
45. c
46. b
47. d
48. c
49. b
50. d
51. b
52. a
53. a
54. d
55. b
56. b
57. b
58. a
59. a
60. c
61. a
62. b
63. c
64. b
65. c
66. b
67. c
68. d
69. b
70. c
71. c
72. b
73. d
74. b
75. c
76. a
77. b
78. a
79. b
80. d
81. d
82. a
83. a
84. d
85. a
86. b
87. c
88. d
89. c
90. d
91. d
92. a
93. c
94. a
95. c
96. d
97. c
98. b
99. b
100. d

MODULE SET I: Introduction to Anatomy and Physiology

Module 3: Infection, Immunology, and Sanitation

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Suggested Activities

INSTRUCTIONAL PLAN

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

PREPARATION

- Review the module in the student edition.
- Review the Teaching Suggestions section that follows on page 4 of the Suggested Activities.
- Review the Resources Used in Developing This Module and the Suggested Supplemental Print Resource sections that follow on page 7 of the Suggested Activities.
- Review the Suggested Web Sites section that follows on page 7 of the Suggested Activities.
- Review the additional resources that follow: Written Test, crossword puzzles, and Module Review.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Select web sites to be inserted on the Learning Activities Sheet in the student edition.
- Select additional activities to be inserted on the Learning Activities Sheet in the student edition.
- Copy the Written Test, crossword puzzles, and Module Review for distribution to your students.
- Prepare supplemental resources for use by your students.

DELIVERY AND APPLICATION

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.

EVALUATION

- Give the Written Test. Reteach and retest as required.
- Review with students the assignment sheet in the student edition.

- Have students complete the assignment sheet.
- Give the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Reteach and retest as required.

TEACHING SUGGESTIONS

✔ **NOTE:** This module has two primary purposes: to teach students about infections and the body's defense mechanisms and to provide information about what students can do to help prevent the spread of infections in the patient and in the health-care facility. Your instruction must be tailored to your facility or those in which your students are likely to work because of the numerous variations in isolation techniques and patient-care precautions. Be sure to involve representatives from local facilities in your planning so that your instruction will accurately reflect current practices.

A major concern of your students will be AIDS and the spread of HIV. If not already covered in your course, plan how you will discuss the topic and how the subject will fit into the overall presentation.

- Use crossword puzzles 1 through 10 to help reinforce the terms in the associated objectives.
- Provide students with copies of the book *A Commotion in the Blood: Life, Death, and the Immune System* by Stephen S. Hall, or provide similar resources that can supplement this module. Use the books as they relate to specific objectives and to support completion of the assignment sheet.
- Ask students if any of them have ever had an infection and ask them to explain what they think an infection is. Guide them to an understanding of the definition used in your course. Use their range of experiences to help them understand the broad application of the term. Some may, for example, think that an infection only occurs when there is redness and pus in a sore. Use what they have learned about cells and microbiology in the previous modules to explain the action of pathogens.
- Discuss the infection process and introduce concepts related to the spread of infection within a host. Relate terms like *incubation period* and *resistance* to experiences that the students have had, such as one member of their family getting a cold followed in the next few days of others getting or not getting colds. Use this opportunity to encourage students to help maintain their resistance through good diet, exercise, getting plenty of rest (instead of cramming for tests), and proper precautions, including frequent, thorough handwashing.
- Objectives 2 and 3 provide something of an overview of some of the topics that will be covered in the module. Do not overwhelm the students with details at this point, but allow the material to build upon itself, occasionally relating subsequent objectives to the information presented. Mention that resistance is a dynamic factor, explaining how pathogens can build up resistance to vaccinations and antibiotics, such as resistant strains of tuberculosis.
- Objective 4 allows you to introduce students to various types of infections and diseases, some of which may be new to them. Provide the students with illustrations of persons infected with the diseases discussed to help them understand about symptoms and the course of infection. For example, show persons in early stages and in advanced stages of tuberculosis.

- In the discussion of phases of a disease in Objective 5, help the students to understand that the health-care professional's goal is to bring about efficient convalescence with as little suffering or loss of body functions as possible; stress that this is not always possible. Provide anecdotes or have other health-care professionals share stories of their victories and losses.

- In discussing the portals of entry and exit in Objective 6, the students have a chance to examine their own vulnerabilities. Relate incidents of contamination when a health-care professional was confident that adequate protection had been provided to both the patient and attending personnel. Introduce precaution procedures and equipment briefly to help students understand that protection is a team effort.

- For Objective 7, use illustrations or actual equipment with a blacklight system or other process to reveal the contamination of living hosts and inanimate objects. Have the students discuss how they could handle objects without spreading the contamination. Role play a few scenes in which bed linens are soiled, instruments must be passed, patients have to be moved, etc., to get students thinking about control of infectious contamination.

- The objective on factors that determine whether a pathogen will cause a disease (Objective 8) should now offer an opportunity for lively discussion. Encourage the students to expand on each factor and to consider the influences of the patient, the facility, caregivers, medical treatment, and other circumstances that make the factor more or less significant.

- For Objective 9, use the same strategy as used in Objective 8 to discuss the term *virulence.*

- For Objective 10, use illustrations or demonstrations to discuss the body's physical barriers. Ensure that your demonstrations represent good practices. For example, water can be used to represent perspiration, saliva, and tears. Discuss natural flora, building on or recalling your presentation from the previous module.

- To supplement Objective 11, have the class discuss how they believe special structures, chemicals, and actions help to protect the body against infection.

- Combine Objectives 12 and 13 to discuss immunology and types of immunity. Discuss types of diseases that are specific to humans or other species, that are specific to races and cultures, and that are more likely to occur in offspring if a parent exhibits the disease. Ensure that the students recognize that two types of differentiation are being made: the type of acquisition (natural or artificial) and the type of immunity (active or passive).

✔ **NOTE:** The next series of suggested activities provides instruction on the body's defense responses to pathogen invasion. Objective 14 provides an overview of the major cellular and tissue defense mechanisms, while the subsequent objectives provide additional details about each type of defense response. Help the students understand how the objectives relate to the types of defense mechanisms as you provide instruction.

- Provide illustrations of the defense mechanisms described in Objective 14 to allow the students to visualize each. Numerous videotapes are available that show phagocytosis and serum responses. Your purpose here is to get the students to make an at-large correlation between the defense mechanisms and their response sites and components involved so that the following material will fall into place more easily.

- To supplement Objective 15, provide illustrations of the various types of white blood cells. Point out that further information will be presented about the components of blood in later modules, but since an important role of blood is to fight infections, that aspect of blood must be discussed here. Point out that white blood cells are involved in a number of ways in the various types of defense mechanisms, particularly monocytes and lymphocytes.

- To supplement your discussion of Objective 16, discuss natural and artificial interferon. This provides you with a good opportunity to discuss medical research and the differences between expectations and reality. Early on, interferon was thought to be a potential cure for cancer. While it has demonstrated a degree of effectiveness against some cancers, its real success is in hepatitis and some unusual cancers.

- Phagocytosis has already been mentioned several times; however, in Objective 17, the students need to realize that it is a separate defense mechanism, as when neutrophils attack pathogens, as well as a step in most of the other defense responses, such as the interferon response just discussed.

- When discussing Objective 18, remind students that lymphocytes are a type of white blood cell involved in the defense response in two broad categories based on their origin. While B cells are actually so designated due to their discovery in chicken bursae, it is convenient to help distinguish between T cells and B cells by relating the T to *thymus* and the B to *bones.*

- For Objectives 19 through 23, use illustrations and videotapes to explain the action of T cells and B cells in a general way, basically to get students to recognize that they perform specialized functions. Then relate T cells to cell-mediated immunity and B cells to humoral- or antibody-mediated immunity. Again, the B might be helpful in remembering *antiBody.* Continue the discussion by covering what happens in each type of immunity development. Then relate the phases of antibody development to humoral-mediated immunity development.

- Remind students of what they have previously learned about inflammation when discussing Objective 24. Then relate the process to controlling the spread of disease. Help the students understand the role of the cells that accumulate in an inflamed site based on the discussion in the preceding objectives.

- For Objectives 28 through 31, demonstrate physical and chemical methods of antimicrobial control. Discuss the effectiveness of each and relate the methods to specific precautions.

- To supplement Objective 33, have health-care professionals discuss their experiences with nosocomial infections. Role play some of the procedures to allow students to get a sense of improper techniques and a false sense of security. For example, you may have one set of students demonstrate patient care with the risk of nosocomial infection and have other students observe and identify potential problems with the methods used.

- Also, for Objective 33, provide illustrations of the various types of nosocomial organisms and discuss the risks they represent, as well as the effectiveness of precautions in relation to specific infectious agents.

- Demonstrate the various types of patient isolation and handling that are discussed in Objective 34. Discuss reasons for each. Emphasize procedures as they are practiced in your community.

- Demonstrate and have students practice the recommended precautions for surgical suites that are presented in Objective 35. Tailor the presentation to local practices and equipment. Emphasize the need to accommodate surgical procedures, patient's condition and secondary factors (HIV-positive or active tuberculosis), facility practices, and other issues when planning surgical-suite procedures. Have students discuss the reasoning behind these procedures. For example, ask why used needles should not be recapped or why staples may be preferred over sutures.

RESOURCES USED IN DEVELOPING THIS MODULE

- *Anatomy and Physiology.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1993.
- *Core Curriculum for Surgical Technology,* 4th ed. Englewood, CO: Association of Surgical Technologists, Inc., 1996.
- Gylys, Barbara A., and Regina Masters. *Medical Terminology Simplified*, 2nd ed. Philadelphia: F.A. Davis Company, 1998.
- Gray, Henry. *Gray's Anatomy*, 15th ed. New York: Gramery Books, 1977.
- Kwon-Chung, K. J., and John E. Bennett. *Medical Mycology.* Philadelphia: Lea and Febiger, 1992.
- Scanlon, Valerie C. *Essentials of Anatomy and Physiology,* 3rd ed. Philadelphia: F.A. Davis Company, 1999.
- Sherris, David A., and Eugene B. Kern. *Basic Surgical Skills*. Rochester, MN: Mayo Foundation for Medical Education and Research, 1999.
- Thibodeau, Gary A., and Kevin T. Patton. *Anatomy and Physiology,* 4th ed. St. Louis: Mosby, Inc., 1999.

SUGGESTED SUPPLEMENTAL PRINT RESOURCE

- Hall, Stephen S. *A Commotion in the Blood: Life, Death, and the Immune System.* New York: Henry Holt and Company, 1997.

  This book is a well-told story of the advances made in immunology through the 20th Century. It is excellent source material for student reports and case studies.

SUGGESTED WEB SITES*

✔ **NOTE:** The following web sites offer general information about anatomy and physiology and generally cover more than one body system. Later modules list sites specific to the systems and disorders presented in that module. These sites can be used in a general way with the first four modules included in Module Set I and for specific portions of the sites as they relate to the systems covered in later modules in Module Set II.

- http://harveyproject.org

  The Harvey Project is an international collaboration of educators, researchers, physicians, students, programmers, instructional designers, and graphic artists working together to build interactive, dynamic human physiology course materials on the World Wide Web. Materials produced by the Harvey Project are available free to educational institutions. The site is constantly updated and should be checked often and browsed for overall content. The address provided is for the home page. By clicking the WEB button, you will be taken to an index of links divided into categories such as general physiology and specific systems. The number of links in each category is indicated in parentheses after the topic.

- http://www.hapsweb.org/

  The Human Anatomy and Physiology Society (HAPS) was founded to promote communications among teachers of human anatomy and physiology in colleges, universities, and related institutions; to present workshops and conferences where members can obtain information about the latest developments in the health and sciences fields; and to encourage educational research and publication by HAPS members. The site contains information about society resources, including a newsletter, publications, and resources on the World Wide Web.

- http://www.niagra.edu/~bcliff/hapcstop.html

  This site contains case studies for all AST subject areas. The case studies are free to use as long as their source is acknowledged.

- http://www.nim.nih.gov/research/visible/visible_human.html

  The Visible Human Project's objective is to create complete, anatomically detailed, three-dimensional representations of the normal male and female human bodies. The site contains CT, MR, and cryosection images of male and female cadavers. The male is sectioned at one-millimeter intervals, while the female is sectioned at one-third-of-a-millimeter intervals.

- http://edtech.nepean.uws.edu.au/science/ap/index.html

  This anatomy and physiology resource page contains information, images, suggestions, tips, and stimuli to students preparing for a career in health services. Although based on Australian requirements, much of the information is useful for students in other nations.

- http://www.innerbody.com/htm/body.html

  This site provides a great deal of information on the human body in fun, interactive formats. There is a great deal of emphasis on terminology and body parts.

- http://www.orthop.washington.edu/Bone%20and%20Sources/Sources.idx.html

  Sponsored by the University of Washington, this site offers information on orthopedic-related subjects and links to similar sites.

- http://tray.dermatology.uiowa.edu/DermImag.htm

  This site offers many images of the skin and underlying tissues.

- http://www.ctrµ.auckland.ac.nz/atlas/intro/cardiac.htm

  This site offers an atlas that provides nearly 100 cross-sectional views of the cardiac anatomy created with an MRI scanner. The views are labeled and taken along different axes.

- http://www.prenhall.com/martini/

  This site is geared to five Prentice-Hall textbooks and offers a variety of self-grading quizzes, links to other web sites, a forum for student discussion, and other resources.

- http://www.heartsite.com/index.html

  Although designed for patients with heart-related complaints, this site contains a great deal of information about the heart and its disorders.

- http://www.merck.com/health/

  This site provides a general guide to health that addresses many of the disorders covered in this curriculum.

- http://www-sci.lib.uci.edu/~martindale/MedicalAnatomy.html

  This site provides a wealth of information and many useful graphics about human anatomy.

- http://www.uchsc.edu/sm/chs/gallery/gallery.htm

  This link goes directly to the gallery portion of the Visible Body Project at the University of Colorado.

- http://sln.fi.edu/biosci/biosci.html

  This site allows students to explore the heart, its structure and development, the flow of blood, and its relationship to other body systems. It also presents information about heart health and the history of heart science.

- http://www.maui.net/~jms/brainuse.html

  This site deals primarily with the brain and offers many useful graphics.

- http://www.cid.ch/DAVID/Mainmenu.html

  This is a rich gallery of CAT scans that can be explored through links to various sections of the body.

- http://www.meddean.luc/lumen/MedEd/GrossAnatomy/GA.html

  This site provides many images that include laboratory slides and anatomical cross-sections.

- http://www.med.umich.edu/lrc/Atlas/atlas.html

  ATLAS-plus integrates the use of digitized images, computer graphics, sound, animations, and textual information to teach basic concepts and principles of human anatomy through three courses: gross anatomy, histology, and embryology. The gross-anatomy course includes systemic components and dissection images.

- http://www.rad.washington.edu/anatomy/index.html

  This site features radiological images of the body and the skeletal system.

- http://www9.biostr.washingron.edu/da.html

  This site provides images and information in four areas: the brain, neuroanatomy, thoracic viscera, and the knee.

*Web-site addresses were accurate and all content on referenced web sites was appropriate during development and production of this product. However, web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all web sites prior to use.

Written Test

Name ______________________________

Date ____________________ Score ____________________

OBJECTIVE 1 Define the term *infection*. Write your answer on the blank lines provided beside the term below.

Infection ______________________________

____

____

____

OBJECTIVE 2 Complete statements that describe the effects of infection on a human host. Write your answers on the blank lines provided in the statements below and on the next page.

a. The harmful effects of an infection on a host may be the direct result of an ______________ taken by a pathogen or the result of ______________ produced by the pathogen.

b. The ability of an infecting organism to harm a host is referred to as ______________.

c. The ability of a host to avoid infection and reduce harm caused by an infecting organism is called ______________.

d. An infection may result in observable ______________ in a host, or the infection may occur without ______________.

e. The period of time between the incidence of infection and the appearance of symptoms in a host is referred to as the ______________ period.

f. An infection in a host may be ______________, limited to only one organ or site, or it may be ______________, affecting the entire body.

g. The host's body produces special ______________ that recognize pathogens and destroy them.

h. ____________________ diseases are infections that can be spread from one human host to another through direct or indirect contact.

OBJECTIVE 3

Complete statements that describe methods used to reduce the spread of infection. Write your answers on the blank lines provided in the statements below.

a. The spread of infection can be reduced by using ________________ practices, cleaning with disinfectants, and sterilizing instruments and surgical materials.

b. Some infections can be prevented through ________________, the administration of a medication that increases the body's resistance to a specific pathogen.

c. Once an infection has occurred, ________________—special medications that slow or stop the growth of certain microorganisms—can be used to improve the body's ability to fight the infection.

OBJECTIVE 4

Match types of infections and diseases to their correct descriptions. Write the numbers on the blanks provided.

1. Acute infection
2. Chronic infection
3. Latent infection
4. Localized infection
5. Mixed infection
6. Nosocomial infection
7. Primary disease
8. Secondary disease
9. Systemic infection

_______ a. An infection that is contracted in a hospital or other health-care facility, such as a nursing home

_______ b. An infection that has spread throughout a host's body from an initial site

_______ c. The first-occurring infection within a period of illness

_______ d. A subsequent infection or complication to an existing condition

_______ e. An infection that lasts for a long period of time—from weeks to several years

_______ f. An infection that involves only one organ or site of a host's body

_______ g. An infection that results from more than one organism

_______ h. An infection that runs a rapid and severe course and then ends abruptly

_______ i. An infection that has no apparent symptoms

OBJECTIVE 5

Define the phases in the course of a disease. Write your answers on the blank lines provided beside each of the terms below.

a. Incubation ______________________________________

____

b. Illness ______________________________________

____

c. Convalescence or death ______________________________________

____

OBJECTIVE 6

Complete statements that describe the role of the body's portals of entry and portals of exit in the spread of infectious diseases. Write your answers on the blank lines provided in the statements below.

a. The most-common portals of entry for pathogens are ______________ and natural body openings such as the ______________, ______________, and ______________ openings.

b. The most-common portals of exit for pathogens are ______________ and natural body openings such as the ______________, ______________, and ______________ openings.

c. Typically, a disease will spread from an infected host's portals of ______________ to a second host's portals of ______________.

d. Hosts who have recovered from a disease or who are asymptomatic may be ______________ and transmit the disease to others.

e. ______________ spread to humans from animals.

f. ______________ that live in the soil, on other surfaces, or in contaminated foods can also enter the body through portals of entry.

OBJECTIVE 7

List sources of the microorganisms that cause infectious diseases. Write your answers on the blank lines provided below.

a. ______________________________________

b. ______________________________________

OBJECTIVE 8 List the factors that determine whether a pathogen will cause a disease in a host's body. Write your answers on the blank lines provided below.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

OBJECTIVE 9 Define the factors that influence the virulence of a pathogen in a host's body. Write your answers on the blank lines provided beside each of the terms below.

a. Ability to infect ____________________

b. Invasiveness ____________________

c. Toxigenicity ____________________

OBJECTIVE 10 State the functions of the body's physical barriers to infection. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Perspiration ____________________

b. Tears ____________________

c. Saliva ____________________

d. Vaginal secretions ____________________

e. Mucus ____________________

f. Cerumen ______________________

____

g. Normal flora ______________________

____

OBJECTIVE 11

State the functions of the special structures, chemicals, and actions within the body that provide protection against infection. Write your answers on the blank lines beside each of the terms below.

a. Ciliated membranes ______________________

____

b. Lysozymes ______________________

____

c. Digestive fluids ______________________

____

d. Normal flora ______________________

____

e. Flushing actions ______________________

____

f. Protective reflexes ______________________

____

OBJECTIVE 12

Define the term *immunology*. Write your answer on the blank lines provided beside the term below.

Immunology ______________________

____

OBJECTIVE 13

Define the types of immunity. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Genetic immunity ______________________

____

____

b. Naturally acquired active immunity ______________________________

c. Artificially acquired active immunity ______________________________

c. Naturally acquired passive immunity ______________________________

e. Artificially acquired passive immunity ______________________________

OBJECTIVE 14

Define the types of cellular and tissue defense-mechanism processes the body uses against disease and infection. Write your answers on the blank lines provided beside each of the terms below.

a. Phagocytosis ______________________________

b. Serum-protein response ______________________________

c. Interferon response ______________________________

d. Inflammatory reaction ______________________________

OBJECTIVE 15

Match types of white blood cells to their correct descriptions. Write the numbers on the blanks provided.

1. Basophil
2. Eosinophil
3. Lymphocyte
4. Monocyte
5. Neutrophil

_______ a. One of two types of white blood cells—a T cell or a B cell—that performs various functions related to recognizing, marking, and remembering pathogens based on their antigens

_______ b. A type of white blood cell that is the first to respond to an inflammatory reaction, where it performs phagocytosis on pathogens

_______ c. A type of white blood cell that is believed to neutralize toxins such as those secreted by some pathogens

_______ d. A type of white blood cell that, as part of the inflammatory reaction, releases chemicals that allow the capillaries to be penetrated by white blood cells and other substances that accumulate at an infection site

_______ e. A type of white blood cell that enlarges to form a macrophage in order to perform more-rapid phagocytosis

OBJECTIVE 16

Describe the stages of the interferon response. Write your answers on the blank lines provided beside each of the terms below.

a. Invasion ____

____

b. Synthesis ____

____

c. Release ____

____

d. Interference ____

____

e. Phagocytosis ____

____

OBJECTIVE 17

Describe the stages of phagocytosis. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Invagination ____

____

b. Engulfment ____

____

c. Vacuole formation ____

____

d. Fusing ____

____

e. Release ____

____

Objective 18

Distinguish between the definitions of a T cell and a B cell. Write an "X" on the blank before the definition of a T cell.

_______ a. Type of lympocyte that is formed in fetal bone marrow and moves directly to the lymph nodes and spleen

_______ b. Type of lympocyte that is formed either in the fetal thymus gland or in the bone marrow and passes through the thymus on its way to the lymph nodes and spleen

Objective 19

Match types of T cells and B cells to their correct functions. Write the numbers on the blanks provided.

1. Activated B cells
2. Cytotoxic T cells
3. Helpter T cells
4. Inactive B cells
5. Memory B cells
6. Memory T cells
7. Plasma cells
8. Sensitized helper T cells
9. Suppressor T cells

_______ a. Carry the imprint of a particular pathogen's antigens and store the imprint in preparation for future invasions of the pathogen

_______ b. Suppress the immune response once a foreign antigen has been destroyed

_______ c. Seek out phagocytes that have engulfed pathogens and examine the antigens of captured pathogens; may also present the foreign antigen to B cells

_______ d. Produce antibodies specific to a pathogen's antigen and tag the pathogen cells for destruction by phagocytes

_______ e. Chemically rupture the cell membrane of infected cells to prevent the pathogen from reproducing and also produce chemicals called *cytokines* that attract phagocytes to the area where the pathogen is located

_______ f. Divide rapidly to produce memory, cytotoxic, and suppressor T cells

_______ g. Remember the antigen and will become involved in responding to any subsequent invasion by that pathogen

_______ h. Divide into memory B cells and plasma cells

_______ i. Reside in the liver, spleen, and lymph nodes until exposed to the antigen of their target pathogen

OBJECTIVE 20

Distinguish between descriptions of the types of immunity development in the serum-protein response. Write an "X" on the blank before the description of humoral-mediated immunity.

_______ a. Relies on the production of antibodies that will recognize subsequent invasions of a pathogen

_______ b. Relies on the ability of memory T cells to recognize a pathogen's antigen

OBJECTIVE 21

Describe the stages of cell-mediated immunity development in the serum-protein response. Write your answers on the blank lines provided beside each of the terms below.

a. Phagocyte location ______________________________

b. Sensitization ______________________________

c. Cloning ______________________________

d. Pathogen binding ______________________________

e. Cytokine release ______________________________

f. Macrophage response ______________________________

g. Suppression ______________________________

OBJECTIVE 22

Describe the stages of humoral-mediated immunity development in the serum-protein response. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Sensitization ______________________________

b. Cloning ______________________________

c. Antibody production ______________________________

d. Macrophage response ______________________________

e. Complement cascade ______________________________

OBJECTIVE 23

Define the phases of the antibody-production cycle that follows the body's exposure to an antigen. Write your answers on the blank lines provided beside each of the terms below.

a. Lag phase ______________________________

b. Primary-response phase ______________________________

c. Secondary-response phase ______________________________

OBJECTIVE 24

Describe the stages of the inflammatory reaction. Write your answers on the blank lines provided beside each of the terms below.

a. Constriction ______________________________

b. Dilation ______________________________

c. Exudation ______________________________

d. Barrier formation ______________________________

OBJECTIVE 25

Match types of vaccines to their correct definitions. Write the numbers on the blanks provided.

1. Attenuated living pathogen	4. Killed pathogen
2. Closely related microorganism	5. Nonpathogenic strain
3. Extract of pathogen	6. Toxoid

_______ a. A vaccine that contains components of the pathogen, such as bacterial capsules

_______ b. A vaccine that contains toxins or toxoids of the pathogen

_______ c. A vaccine that contains nonpathogenic organisms that are chemically similar to the target pathogen

_______ d. A vaccine that contains organisms of the same genus as the target pathogen but that are a species or subspecies that is not pathogenic

_______ e. A vaccine that contains nonliving or inactivated pathogens

_______ f. A vaccine that contains live weakened or less-virulent forms of the target pathogen

OBJECTIVE 26

Define the term *hypersensitive response*. Write your answer on the blank lines provided beside the term below.

Hypersensitive response ____

____

OBJECTIVE 27

Define the types of hypersensitive responses. Write your answers on the blank lines provided beside the terms below.

a. Immediate ____

____

b. Delayed ____

____

c. Autoimmunity ____

____

d. Isoimmunity ____

____

OBJECTIVE 28

Match methods used to control the spread of microorganisms to their correct definitions. Write the numbers on the blanks provided.

1. Antiseptic
2. Broad-spectrum antibiotic
3. Disinfectant
4. Narrow-spectrum antibiotic
5. Pasteurization
6. Sterilization

_______ a. A chemical used to treat infections caused by a specific kind of bacterium or a few kinds of bacteria

_______ b. A process that destroys pathogens on surfaces

_______ c. A chemical used to treat bacterial infections that may be caused by a wide variety of bacteria

_______ d. A process of heating a food to destroy pathogens in the food

_______ e. A chemical used to destroy or reduce the growth of pathogens on people

_______ f. A chemical used to destroy or reduce the growth of pathogens on objects

OBJECTIVE 29

State reasons certain industries must control the growth of microorganisms. Write your answers on the blank lines beside each of the terms below.

a. Public health ______________________________

____

b. Food preservation ______________________________

____

c. Production of sterile products ______________________________

____

d. Research ______________________________

____

OBJECTIVE 30

Describe the factors that determine the effectiveness of an antimicrobial procedure. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Immediacy of initial treatment ______________________________

____

____

____

b. Interval between treatments ____________________

c. High temperature ____________________

d. Low temperature ____________________

e. Concentration ____________________

f. Type of microbe ____________________

g. Number of microbes ____________________

h. Microbial defense ____________________

OBJECTIVE 31

Match types of antimicrobial-control methods to their correct descriptions. Write the numbers on the blanks provided.

1. Antiseptic
2. Barrier
3. Cold
4. Disinfectant
5. Dry heat
6. Drying
7. Filtration
8. Moist heat
9. Pressurized steam
10. Radiation
11. Sterilant
12. Ultrasonic waves

_______ a. Physical method that will not generally kill microbes but is used to slow their growth

_______ b. Physical method used to reduce the growth of fungi and some bacteria

_______ c. Chemical method used to destroy all organisms on inanimate objects

_______ d. Physical method used to prevent microbes from reaching portals of entry

_______ e. Physical method used to control microbes in a fluid (liquid or gas) by forcing the fluid through a material with openings that allow the fluid to pass through but are too small to allow pathogens to pass through, leaving pathogens trapped in the material

_______ f. Chemical method used to destroy bacteria on inanimate objects

_______ g. Chemical method used to destroy bacteria on living organisms

_______ h. Physical method used to kill microbes through the combined effect of heat and water that is at a temperature short of boiling

_______ i. Physical method used to kill microbes on materials that can be safely exposed to microwaves

_______ j. Physical method used to kill microbes on materials such as plastics that cannot be subjected to high temperatures

_______ k. Physical method used to kill all microbes and their spores through the effects of an autoclave

_______ l. Physical method used to kill microbes through the effects of heat from a source such as an oven or an infrared light

OBJECTIVE 32

List factors that contribute to the spread of nosocomial infections. Write your answers on the blank lines provided below and on the next page.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

OBJECTIVE 33

Match organisms that cause common nosocomial infections to the infections they cause. Write the numbers on the blanks provided.

1. Esherichia coli
2. Hepatitis B virus
3. Human immunodeficiency virus (HIV)
4. Human papilloma virus
5. Mycobacterium species
6. Pseudomonas aeruginosa
7. Staphylococcus aureus
8. Streptococcus species

_______ a. Involved in "strep" throat, scarlett fever, pneumonia, rheumatic heart disease, and other communicable conditions

_______ b. Responsible for various infections referred to as *colitis*

_______ c. Presents a particular hazard for various infections to burn victims, patients with cystic fibrosis, and those patients with certain types of cancer where the skin and mucous membranes do not afford adequate protection

_______ d. Responsible for AIDS

_______ e. Associated with several types of cancer, including cancers of the mouth and cervix

_______ f. Responsible for tuberulosis and leprosy and present a particular hazard for various infections to patients with low resistance, such as those with acquired immunodeficiency syndrome (AIDS), to those receiving immunosuppressors, and to those with pulmonary conditions

_______ g. Responsible for hepatitis

_______ h. Responsible for a number of post-operative infections commonly referred to as *staph infections*

OBJECTIVE 34

Describe types of patient isolation used in health-care facilities. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Total ______________________________

____

b. Protective ______________________________

____

c. Enteric ______________________________

____

d. Wound and skin ______________________________

____

e. Respiratory ______________________________

____

f. Blood/body fluids ______________________________

____

OBJECTIVE 35

Complete statements that describe recommended precautions and guidelines used in surgical suites to reduce the spread of infection. Write your answers on the blank lines provided in the statements below.

a. Hands and other skin surfaces should be ______________ immediately and thoroughly if contaminated with blood or other body fluids.

b. Handling of body fluids and specimens should only be done while wearing ______________, ______________, ______________, and ______________.

c. Hands should be washed immediately after ______________ are removed.

d. Used sharps should be placed in disposable containers, using ______________ passing.

e. Used needles should not be ______________.

f. ______________ should be used instead of sutures whenever possible.

g. After they are used, disposable syringes and needles, scalpel blades, and other sharp items should be placed in ____________________________ for disposal.

h. Reusable instruments and equipment should be subjected to a level of ______________ that will ensure terminal exposure for pathogens.

i. Health-care workers who have ______________ or ______________ that exude ______________ should refrain from all direct patient care and from handling patient-care equipment until the condition resolves.

Answers to Written Test

OBJECTIVE 1

An invasion of a body by organisms and the reaction of the body to the presence of those organisms and to the toxins that they produce; the presence and multiplication of an organism that results in harm or disease to a host

OBJECTIVE 2

a. action; toxins
b. virulence
c. resistance
d. symptoms; symptoms
e. incubation
f. localized; systemic
g. cells
h. Communicable

OBJECTIVE 3

a. antiseptic
b. vaccinations
c. antibiotics

OBJECTIVE 4

a. 6
b. 9
c. 7
d. 8
e. 2
f. 4
g. 5
h. 1
i. 3

OBJECTIVE 5

a. The period of time between the incidence of an infection and the appearance of symptoms in a host

b. The period of time during which a host exhibits symptoms of a disease

c. The resolution of a disease, resulting in a host's recovery or death

OBJECTIVE 6

a. breaks in the skin; nose; mouth; genitourinary
b. skin lesions; nose; mouth; genitourinary
c. exit; entry
d. carriers
e. Zoonoses
f. Pathogens

OBJECTIVE 7

Answers may appear in any order.

a. Living hosts
b. Inanimate objects or materials

Objective 8

Answers may appear in any order.

a. Site of the pathogen invasion
b. Antibacterial techniques
c. Normal flora
d. Bacteriocidins
e. Antibodies
f. Phagocytes

Objective 9

a. The capacity of an organism to cause disease despite a host's resistance

b. The level of success an organism experiences upon entering a host; a measure of the number of organisms that are able to enter a host's body

c. The relative strength of and the amount of toxins produced by an organism

Objective 10

a. Helps to cleanse the pores and raise the level of acidity on the skin

b. Rid the eyes of contaminants and help to seal and lubricate the eyelids to prevent entry of organisms

c. Contains enzymes that help break down invading pathogens and prevent them from colonizing in the mouth

d. Maintain a slightly acidic environment to prevent microorganisms from becoming established

e. Provides a coating that prevents pathogens from making direct contact with the skin

f. Provides a coating that prevents pathogens from contacting delicate areas of the skin in the ear canal

g. Compete with invading microorganisms to prevent them from becoming established

Objective 11

a. Present physical barriers to contaminated particles and help to hold mucus in place
b. Inhibit the growth of bacteria in tears and saliva
c. Inhibit the growth of bacteria in the stomach and intestines
d. Compete with invading pathogens
e. Remove pathogens through the movement of liquids
f. Generally expel contaminated substances from the body

Objective 12

The study of the ways in which the body resists infection

OBJECTIVE 13

a. Immunity based on one's inherited genetic makeup rather than on the production of antibodies

b. Long-term immunity acquired when a person contracts a disease and his or her body naturally produces antibodies in response to the pathogen and memory cells that protect that person from the pathogen

c. Long-term immunity acquired when a person is given a vaccine and his or her body produces antibodies in response to the vaccine and memory cells that protect that person from the pathogen

d. Temporary immunity acquired when antibodies are passed to a fetus through the mother's blood or to an infant through the mother's milk when the infant is breastfeeding

e. Temporary immunity acquired when an immune serum is injected into a person's bloodstream

OBJECTIVE 14

a. The process in which a moving cell engulfs a mass of foreign material

b. The process by which components of the blood and lymph analyze captured pathogens to help develop immunity reactions to the pathogens

c. The process by which a cell releases chemicals that interfere with a virus' ability to reproduce within a cell

d. The process by which tissues in an area of injury or infection work to trap pathogens in the area

OBJECTIVE 15

a. 3
b. 5
c. 2
d. 1
e. 4

OBJECTIVE 16

a. The virus enters the cell.
b. The infected cell produces interferon.
c. The infected cell releases interferon into the bloodstream.
d. Interferon chemically attacks the virus and prevents it from multiplying.
e. The infected cell and the inhabiting virus are engulfed by a phagocyte.

OBJECTIVE 17

a. A phagocyte folds part of itself to create pseudopods that pull a pathogen to the body of the phagocyte.

b. The pathogen is completely surrounded by the body of the phagocyte.

c. The phagocyte creates a vacuole around the engulfed pathogen.

d. A lysosome fuses with the vacuole so that the contents of the lysosome are emptied into the vacuole containing the engulfed pathogen.

e. The phagocyte releases the contents of the vacuole or dies and then eventually decomposes.

OBJECTIVE 18 b

OBJECTIVE 19

a. 6
b. 9
c. 3
d. 7
e. 2
f. 8
g. 5
h. 1
i. 4

OBJECTIVE 20 a

OBJECTIVE 21

a. T cells are released in a form called *helper T cells* to seek out phagocytes that have engulfed pathogens.

b. The T cells become sensitized to the pathogen antigens in the phagocytes.

c. The sensitized helper T cells form other sensitized helper cells and memory, cytotoxic, and suppressor T cells.

d. The cloned cells travel to the site of the infection and attach to the antigen of pathogen cells.

e. The cytotoxic T cells secrete cytokines to disrupt pathogen metabolism and to attract phagocytes to the area.

f. Macrophages migrate to the infection site and engulf pathogens and damaged cells.

g. Suppressor T cells secrete macrophage-inhibiting chemicals once the foreign antigen has been destroyed.

OBJECTIVE 22

a. Helper T cells present the pathogen antigen to B cells, which become sensitized to the antigen.

b. The B cells form memory B cells and plasma cells.

c. The plasma cells produce antibodies specific to the pathogen's antigen and tag the pathogen cells for destruction by phagocytes.

d. Macrophages migrate to the infection site and engulf pathogens and damaged cells.

e. Enzymes in the plasma cause a chain of chemical reactions that result in the complement components rupturing pathogen cells and in other actions such as attracting neutrophils to the site.

OBJECTIVE 23

a. The phase during which the body detects an unrecognized foreign antigen and begins to react

b. The phase during which the body produces (1) antibodies that "fit" the previously unrecognized antigen and (2) memory cells that will recognize that antigen during any subsequent exposure

c. The phase during which the body is exposed to a subsequent invasion by an antigen, the memory cells immediately recognize the antigen, and the body produces antibodies against it

OBJECTIVE 24

a. The blood vessels constrict to allow blood to pool at the affected site.

b. The blood vessels dilate, and white blood cells gather in the affected site to fight infection.

c. The injured or infected cells secrete exudate that causes the area to swell.

d. The exudate creates a fibrous network that prevents pathogens from spreading from the area.

OBJECTIVE 25

a. 3
b. 6
c. 2
d. 5
e. 4
f. 1

OBJECTIVE 26

An excessive response by the body's immune system to a foreign substance

OBJECTIVE 27

a. Hypersensitive response upon exposure to an allergen and due to an antigen/antibody reaction

b. Hypersensitive response following exposure to an allergen and due to body cells reacting to the allergen

c. Hypersensitive response to one's own antigens

d. Hypersensitive response to antigens from one's own species

OBJECTIVE 28

a. 4
b. 6
c. 2
d. 5
e. 1
f. 3

OBJECTIVE 29

a. To prevent the spread of illness

b. To keep microorganisms from destroying food and to prevent the spread of disease through infected food

c. To prevent contamination of the products during the production process

d. To produce pathogens under controlled circumstances to gain better understanding of them and to develop vaccines and other control measures for them

OBJECTIVE 30

a. The effectiveness of an antimicrobial procedure depends on how quickly the antimicrobial procedure was performed after the possibility of a microbial invasion.

b. The effectiveness of an antimicrobial procedure depends on how much time has passed between the initial antimicrobial procedure and a subsequent procedure.

c. The effectiveness of an antimicrobial procedure is increased if the procedure is performed under extremely high temperatures.

d. The effectiveness of an antimicrobial procedure can be increased if the procedure is performed under extremely low temperatures.

e. The strength of the antimicrobal substance used in an antimicrobial procedure can increase the effectiveness of the procedure.

f. The effectiveness of an antimicrobial procedure is increased when the proper procedure is selected for the type of microbe it will be used against.

g. The effectiveness of an antimicrobial procedure is increased if the procedure is initiated before there are a great number of microbes to be killed.

h. The effectiveness of an antimicrobial procedure is increased if the microbe has not been overly exposed to the procedure and has developed defenses against the procedure.

OBJECTIVE 31

a. 3
b. 6
c. 11
d. 2
e. 7
f. 4
g. 1
h. 8
i. 12
j. 10
k. 9
l. 5

OBJECTIVE 32

Answers may appear in any order.

a. Improper hand-washing techniques
b. Inappropriate use of antibiotics
c. False sense of security
d. Type of surgery performed on patient
e. Caregiver's patient load
f. Type of care procedure performed
g. Facility staffing
h. Administration of an immunosuppressive agent

OBJECTIVE 33

a. 8
b. 1
c. 6
d. 3
e. 4
f. 5
g. 2
h. 7

OBJECTIVE 34

a. Isolation that requires a patient to have no contact with anyone

b. Isolation that requires that a patient not be exposed to infection risks

c. Isolation that requires protection with regard to a patient's intake and output of food and liquids

d. Isolation that requires the use of barriers to prevent contact with moist areas

e. Isolation that requires the use of a mask and separation of a patient from contact with other patients

f. Isolation that requires the use of gloves and other barriers and proper disposal of body fluids and contaminated materials

OBJECTIVE 35

a. washed
b. goggles; masks; gloves; impermeable clothing
c. gloves
d. no-touch
e. recapped
f. Staples
g. puncture-resistant containers
h. sterilization
i. sores; skin conditions; fluids

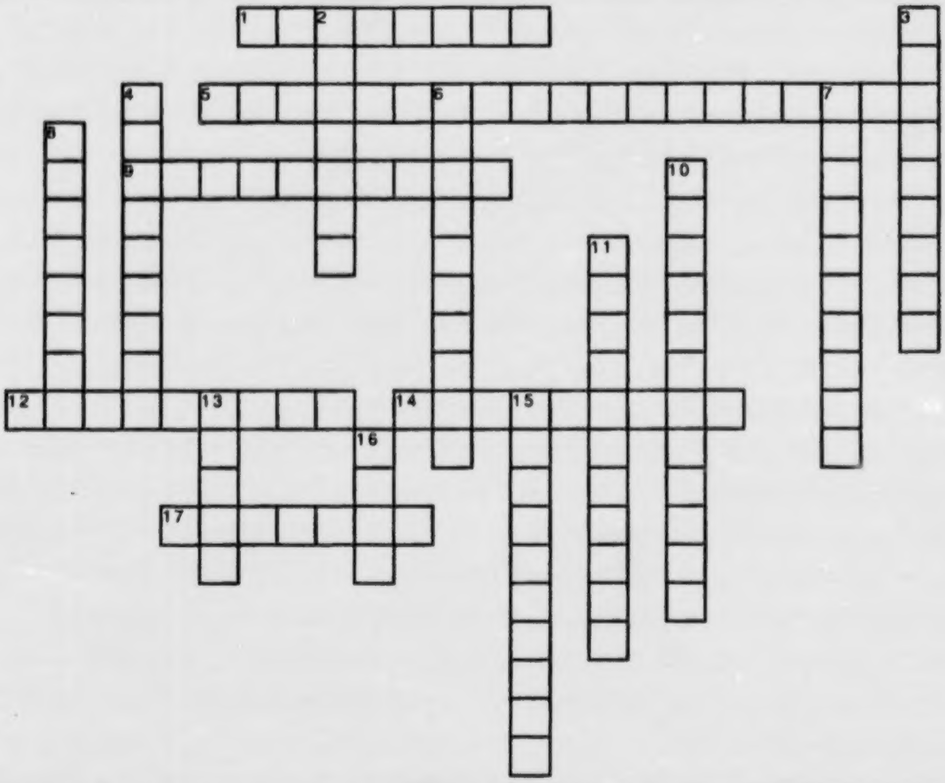
Answers to Assignment Sheet

Assignment Sheet 1

Answers will vary and must be evaluated to the satisfaction of the instructor.

Crossword Puzzle 1—Terms from Objectives 1 Through 3

Name ______________________________ Date ______________



ACROSS

1. An infection that affects the entire body of a host
5. An infection that can be spread from one human host to another through direct or indirect contact (2 words)
9. The ability of a host to avoid infection and reduce harm caused by an infecting organism
12. An invasion of a body by organisms and the reaction of the body to the presence of those organisms and to the toxins that they produce; the presence and multiplication of an organism that results in harm or disease to a host
14. An infection that is limited to only one organ or site
17. A specific illness or disorder characterized by a recognizable set of signs and symptoms and attributable to heredity, infection, diet, or environment

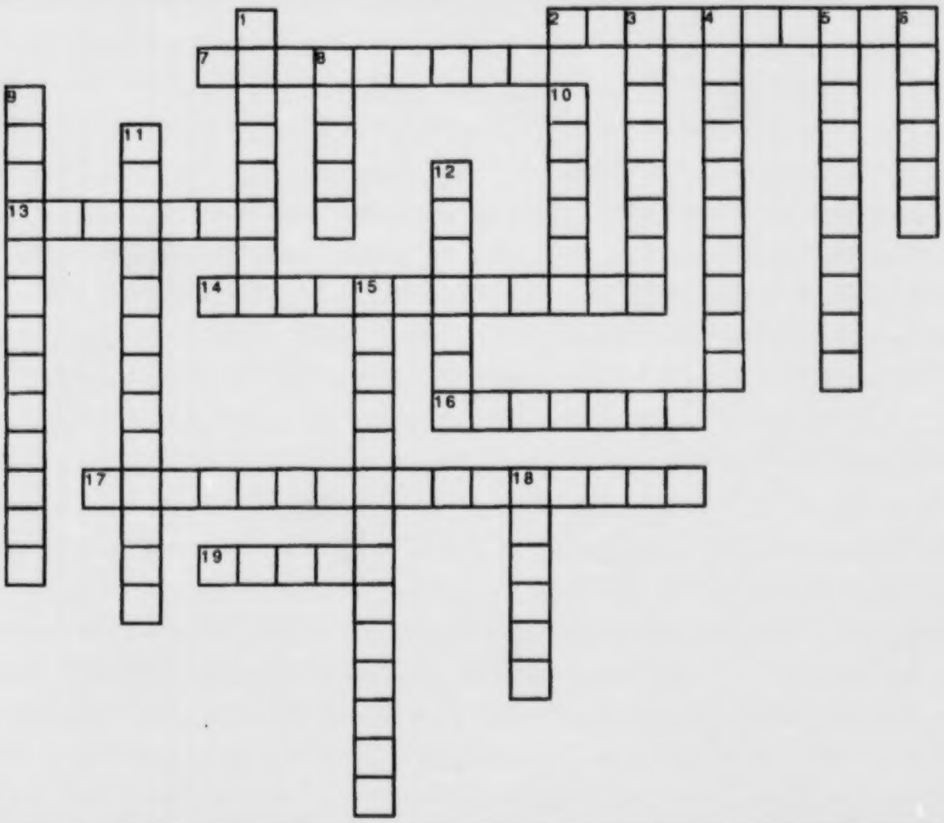
DOWN

2. A condition that occurs in association with a disease and that can be evidence of the presence of the disease
3. To destroy all of the pathogens on an object or in a substance
4. The ability of an infecting organism to harm a host
6. The period of time between the incidence of infection and the appearance of symptoms in a host; the ______ period
7. A chemical used to destroy or reduce the growth of pathogens on a person
8. An organism that is capable of producing disease in another organism
10. A chemical used to destroy or reduce the growth of pathogens on objects
11. The administration of a medication that increases the body's resistance to a specific pathogen
13. A substance that is harmful to cells
15. A special medication that slows or stops the growth of certain microorganisms
16. An organism that serves as a permanent or temporary home for another organism

Module Set I: Introduction to Anatomy and Physiology
Module 3: Infection, Immunology, and Sanitation

Crossword Puzzle 2—Terms from Objectives 4 Through 6

Name ________________________________ Date ______________



ACROSS

2. Type of infection that is contracted in a hospital or other health-care facility, such as a nursing home
7. Type of infection that involves only one organ or site of a host's body
13. The period of time during which a host exhibits symptoms of a disease
14. Being without symptoms
16. An organism capable of spreading disease
17. A subsequent infection or complication to an existing condition (2 words)
19. Type of infection that results from more than one organism

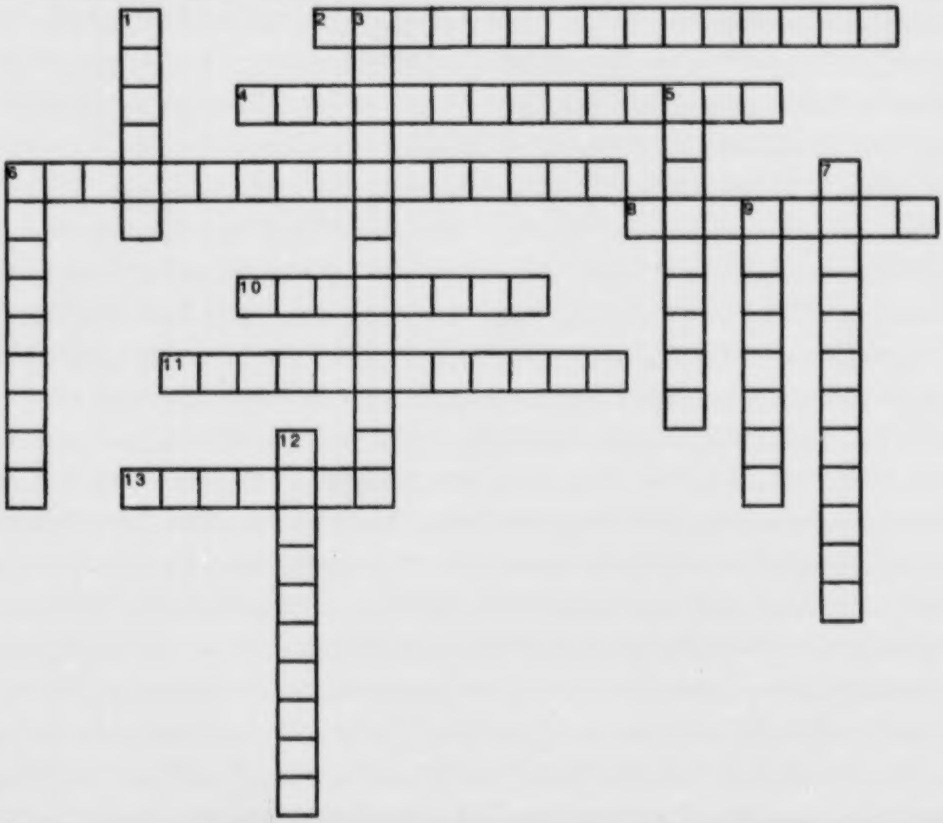
DOWN

1. A disease of animals that is transmissible to humans from its primary animal host
3. Type of infection that has spread throughout a host's body from an initial site
4. Communicable, such as a disease that may be transmitted by direct or indirect contact
5. The period of time between the incidence of an infection and the appearance of symptoms in a host
6. A separation in tissue
8. Type of infection that runs a rapid and severe course and then ends abruptly
9. Referring to the structures and processes associated with urinary functions and reproduction
10. Type of infection that has no apparent symptoms
11. The resolution of a disease, resulting in a host's recovery
12. Type of infection that lasts for a long period of time—from weeks to several years
15. The first-occurring infection within a period of illness (2 words)
18. Substance expelled from the respiratory tract that may contain mucus, pus, cellular materials, blood, and other materials

Module Set I: Introduction to Anatomy and Physiology
Module 3: Infection, Immunology, and Sanitation

Crossword Puzzle 3—Terms from Objectives 7 Through 12

Name ______________________________ Date ______________



ACROSS

2. The capacity of an organism to cause disease despite a host's resistance (3 words)
4. The degree to which a person is likely to contract a disease
6. Coughing, sneezing, vomiting, tearing of the eyes, or other action that provides protection against pathogens (2 words)
8. A specialized protein produced in the blood plasma in response to bacteria, viruses, or other antigenic substances
10. An enzyme with antiseptic actions that destroys some foreign organisms
11. The level of success an organism experiences upon entering a host
13. Ear wax, a secretion of the ceruminous glands in the ear canal

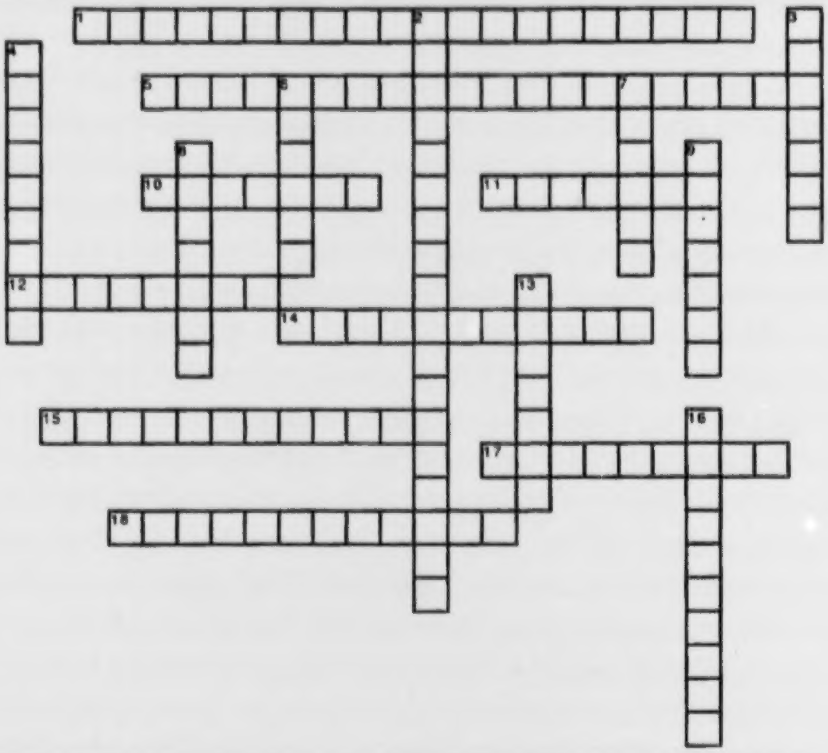
DOWN

1. An inanimate object that is contaminated with pathogens and is capable of transmitting pathogens to a human host
3. A medication that kills bacteria
5. Nonliving
6. A cell within the body that destroys invading organisms by engulfing and surrounding them
7. The relative strength and the amount of toxins produced by an organism
9. The state of being protected from the effects of a pathogen, generally due to having received a vaccination or because of the body's production of antibodies from a previous exposure to the organism
12. The study of the ways in which the body resists infection

Module Set I: Introduction to Anatomy and Physiology
Module 3: Infection, Immunology, and Sanitation

Crossword Puzzle 4—Terms from Objectives 13 Through 16

Name ______________________________ Date ______________



ACROSS

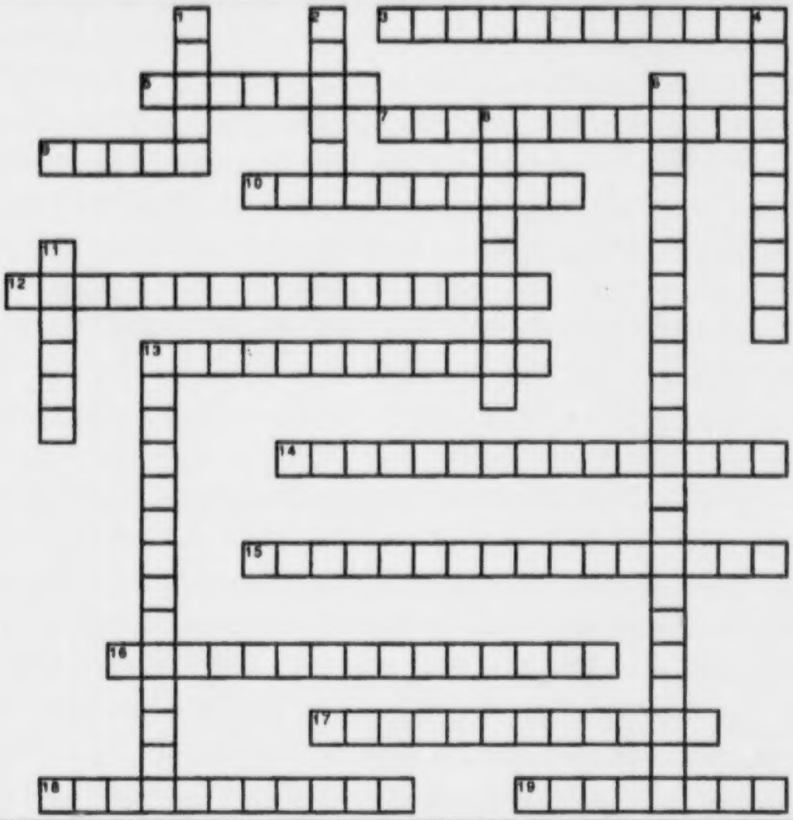
1. The process by which components of the blood and lymph analyze captured pathogens to help develop immunity reactions to the pathogens (3 words)
5. The process by which tissues in an area of injury or infection work to trap pathogens in the area (2 words)
10. Type of temporary immunity acquired when antibodies are passed to a fetus through the mother's blood or to an infant through the mother's milk when the infant is breast-feeding; naturally acquired ______ immunity
11. A suspension of diluted or killed microorganisms administered in order to stimulate the production of antibodies to promote an active immunity to that pathogen
12. Stage in the interferon response in which the virus enters the cell
14. A serum that is taken from another organism (animal or human) and that contains antibodies against a specific disease (2 words)
15. The process in which a moving cell engulfs a mass of foreign material
17. A chemical that makes capillaries more permeable
18. Stage in the interferon response in which the interferon chemically attacks the virus and prevents it from multiplying

DOWN

2. The process by which a cell releases chemicals that interfere with a virus' ability to reproduce within a cell (2 words)
3. Type of immunity based on one's inherited genetic makeup rather than on the production of antibodies
4. Stage in the interferon response in which the infected cell produces interferon
6. Type of long-term immunity acquired when a person contracts a disease and his or her body naturally produces antibodies in response to the pathogen and memory cells that protect that person from the pathogen; naturally acquired ______ immunity
7. Type of long-term immunity acquired when a person is given a vaccine and his or her body produces antibodies in response to the vaccine and memory cells that protect that person from the pathogen; artificially acquired ______ immunity
8. Type of temporary immunity acquired when an immune serum is injected into a person's bloodstream; artificially acquired ______ immunity
9. Stage in the interferon response in which the infected cell releases interferon into the bloodstream
13. A chemical that helps prevent abnormal blood clotting
16. A flat, elongated cell in the connective tissue

Crossword Puzzle 5—Terms from Objectives 17 Through 19

Name ______________________________ Date ______________



ACROSS

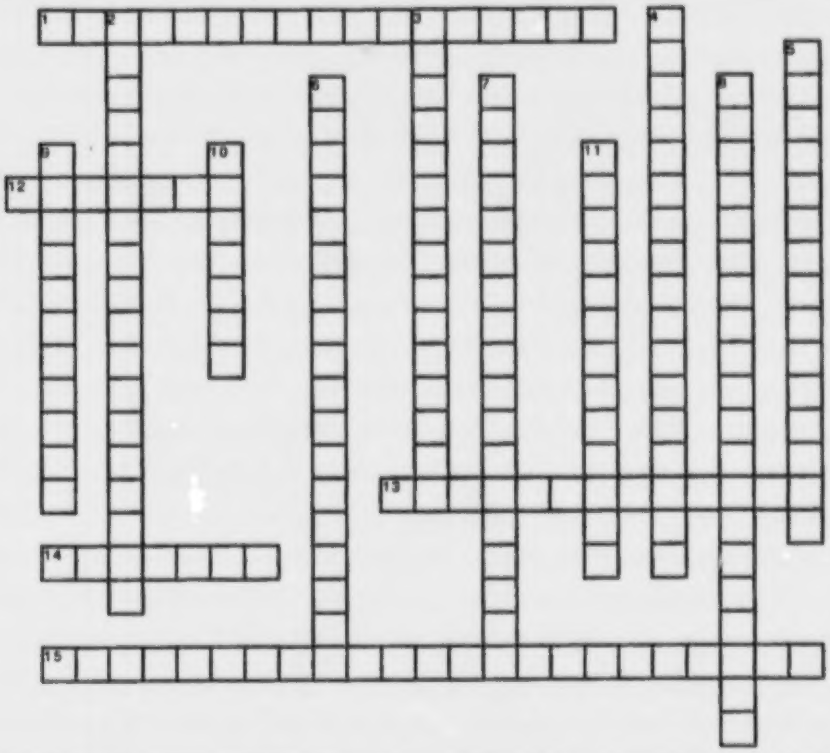
3. Lymphocytes that carry the imprint of a particular pathogen's antigens and store the imprint in preparation for future invasions of the pathogen (3 words)
5. The stage of phagocytosis in which the phagocyte releases the contents of the vacuole or dies and then eventually decomposes
7. Lymphocytes that seek out phagocytes that have engulfed pathogens and examine the antigens of captured pathogens; may also present the foreign antigen to B cells (3 words)
9. Type of lymphocyte that is formed in fetal bone marrow and moves directly to the lymph nodes and spleen (2 words)
10. The stage of phagocytosis in which the pathogen is completely surrounded by the body of the phagocyte
12. The stage of phagocytosis in which the phagocyte creates a vacuole around the engulfed pathogen (2 words)
13. The stage of phagocytosis in which the phagocyte folds part of itself to create pseudopods that pull a pathogen to the body of the phagocyte
14. Lymphocytes that chemically rupture the cell membrane of infected cells to prevent the pathogen from reproducing and also produce chemicals called *cytokines* that attract phagocytes to the area where the pathogen is located (3 words)
15. Lymphocytes that suppress the immune response once a foreign antigen has been destroyed (3 words)
16. Lymphocytes that divide into memory B cells and plasma cells (3 words)
17. Lymphocytes that remember the antigen and will become involved in responding to any subsequent invasion by that pathogen (3 words)
18. Lymphocytes that produce antibodies specific to a pathogen's antigen and tag the pathogen cells for destruction by phagocytes (2 words)
19. A particle that contains digestive enzymes and hydrogen peroxide that chemically dissolve an engulfed pathogen

DOWN

1. Type of lymphocyte that is formed either in the fetal thymus gland or in the bone marrow and passes through the thymus on its way to the lymph nodes and spleen
2. The stage of phagocytosis in which a lysosome fuses with the vacuole so that the contents of the lysosome are emptied into the vacuole containing the engulfed pathogen
4. Capable of being affected by a specific stimulus
6. Lymphocytes that divide rapidly to produce memory, cytotoxic, and suppressor T cells (4 words)
8. An extension of the surface of a phagocyte; a "false foot"
11. The inner structure of most large bones
13. Lymphocytes that reside in the liver, spleen, and lymph nodes until exposed to the antigen of their target pathogen (3 words)

Crossword Puzzle 6—Terms from Objectives 20 Through 22

Name ______________________________ Date ______________



ACROSS

1. Stage of cell-mediated immunity in which T cells are released in a form called *helper T cells* to seek out phagocytes that have engulfed pathogens (2 words)
12. Referring to the old concept of the body having four basic humors or fluids, including the plasma in which humoral-immunity development takes place
13. Stage of humoral-mediated immunity in which helper T cells present the pathogen antigen to B cells, which become sensitized to the antigen
14. Stage of humoral-mediated immunity in which the B cells form memory B cells and plasma cells
15. Type of immunity that relies on the production of antibodies that will recognize subsequent invasions of a pathogen (3 words)

DOWN

2. Stage of humoral-mediated immunity in which the plasma cells produce antibodies specific to the pathogen's antigen and tag the pathogen cells for destruction by phagocytes (2 words)
3. Stage of cell-mediated immunity in which the cytotoxic T cells secrete cytokines to disrupt pathogen metabolism and to attract phagocytes to the area (2 words)
4. Stage of humoral-mediated immunity in which enzymes in the plasma cause a chain of chemical reactions that result in the complement components rupturing pathogen cells and in other actions such as attracting neutrophils to the site (2 words)
5. Stage of cell-mediated immunity in which the cloned cells travel to the site of the infection and attach to the antigen of pathogen cells (2 words)
6. Stage of humoral-mediated immunity in which macrophages migrate to the infection site and engulf pathogens and damaged cells (2 words)
7. Stage of cell-mediated immunity in which macrophages migrate to the infection site and engulf pathogens and damaged cells (2 words)
8. Type of immunity that relies on the ability of memory T cells to recognize a pathogen's antigen (3 words)
9. Stage of cell-mediated immunity in which suppressor T cells secrete macrophage-inhibiting chemicals once the foreign antigen has been destroyed
10. Stage of cell-mediated immunity in which the sensitized helper T cells form other sensitized helper cells and memory, cytotoxic, and suppressor T cells
11. Stage of cell-mediated immunity in which the T cells become sensitized to the pathogen antigens in the phagocytes

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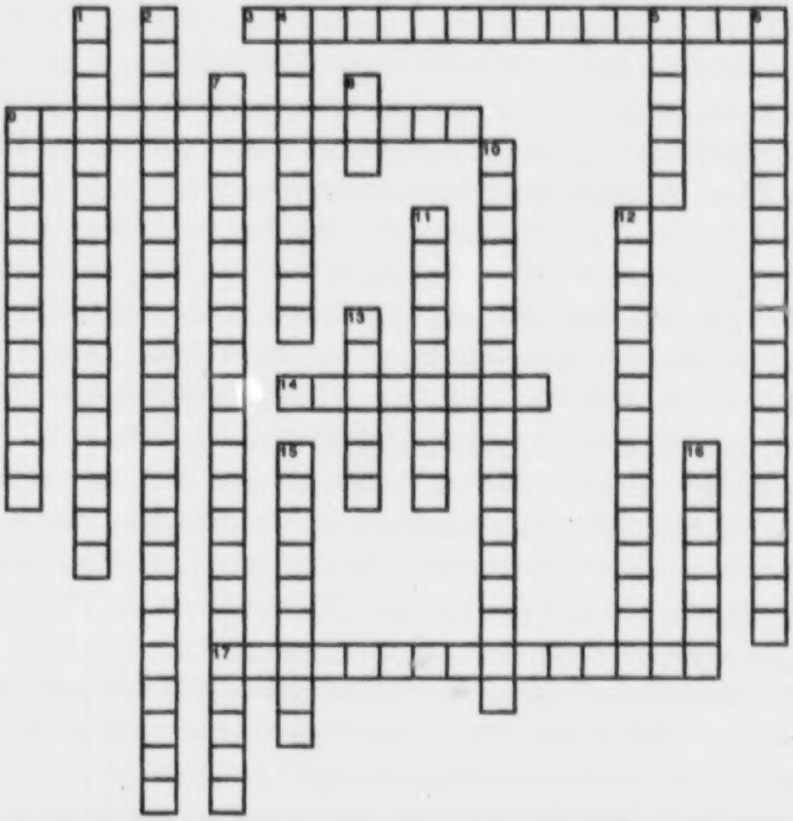
Crossword Puzzle 7—Terms from Objectives 23 Through 26

Name ______________________________ **Date** ______________



ACROSS

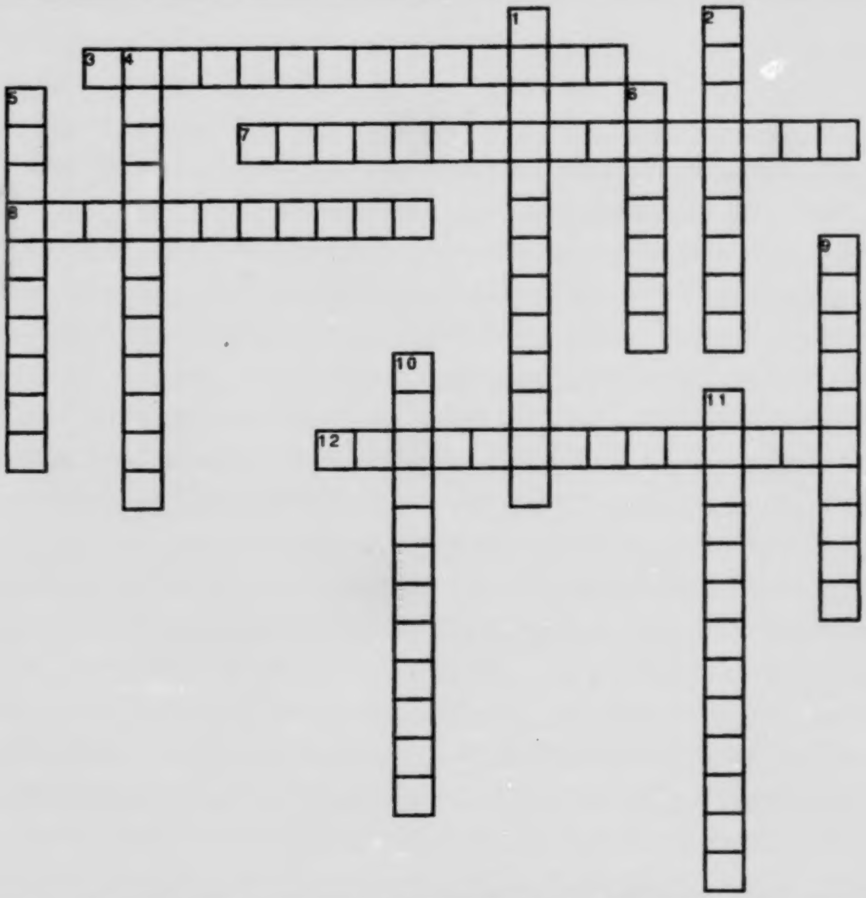
3. Stage of the inflammatory reaction in which the exudate creates a fibrous network that prevents pathogens from spreading from the area (2 words)
9. A vaccine that contains nonpathogenic organisms that are chemically similar to the target pathogen; a ______ ______ microorganism (2 words)
14. Stage of the inflammatory reaction in which the blood vessels dilate, and white blood cells gather in the affected site to fight infection
17. Phase of the antibody-production cycle during which the body produces (1) antibodies that "fit" the previously unrecognized antigen and (2) memory cells that will recognize that antigen during any subsequent exposure (2 words)

DOWN

1. Phase of the antibody-production cycle during which the body is exposed to a subsequent invasion by an antigen, the memory cells immediately recognize the antigen, and the body produces antibodies against it (2 words)
2. A vaccine that contains live weakened or less-virulent forms of the target pathogen (3 words)
4. Weakened or lessened in power or effect
5. A vaccine that contains toxins or toxoids of the pathogen
6. A vaccine that contains organisms of the same genus as the target pathogen but that are a species or subspecies that is not pathogenic (2 words)
7. An excessive response by the body's immune system to a foreign substance (2 words)
8. Phase of the antibody-production cycle during which the body detects an unrecognized foreign antigen and begins to react
9. Stage of the inflammatory reaction in which the blood vessels constrict to allow blood to pool at the affected site
10. A vaccine that contains components of the pathogen, such as bacterial capsules (3 words)
11. Stage of the inflammatory reaction in which the injured or infected cells secrete exudate that causes the area to swell
12. A vaccine that contains nonliving or inactivated pathogens (2 words)
13. To grow larger or expand
15. To grow smaller or narrower
16. A substance that has oozed from a body, such as from a cell

Crossword Puzzle 8—Terms from Objectives 27 Through 30

Name ______________________________ Date ______________



ACROSS

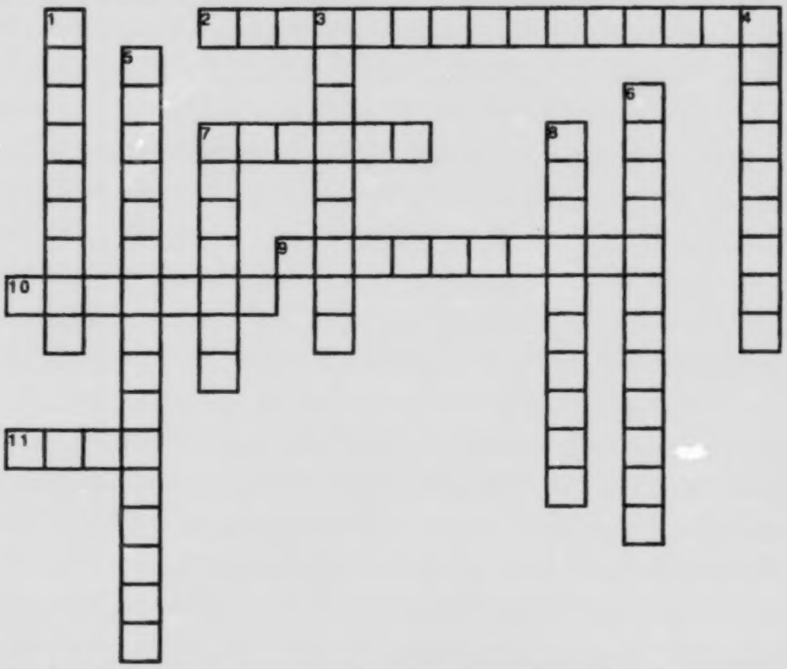
3. A chemical used to treat infections caused by a specific kind of bacterium or a few kinds of bacteria (2 words)
7. A factor that determines the effectiveness of an antimicrobial procedure in which the effectiveness of the procedure is increased if the microbe has not been overly exposed to the procedure and has developed defenses against the procedure (2 words)
8. Hypersensitive response to antigens from one's own species
12. A process of heating a food to destroy pathogens in the food

DOWN

1. A chemical used to treat bacterial infections that may be caused by a wide variety of bacteria (2 words)
2. Hypersensitive response upon exposure to an allergen and due to an antigen/antibody reaction
4. Hypersensitive response to one's own antigens
5. A chemical used to destroy or reduce the growth of pathogens on people
6. Hypersensitive response following exposure to an allergen and due to body cells reacting to the allergen
9. Present at birth as a result of conditions in the womb
10. A chemical used to destroy or reduce the growth of pathogens on objects
11. A process that destroys pathogens on surfaces

Crossword Puzzle 9—Terms from Objective 31

Name ______________________________ Date ______________



ACROSS

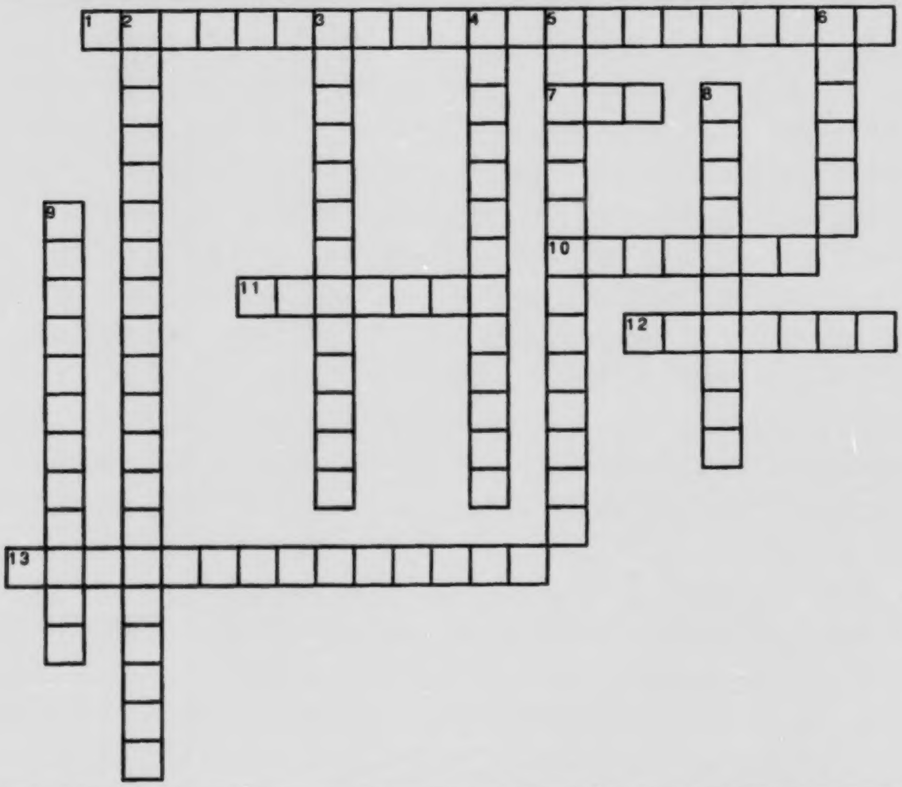
2. Physical method used to kill microbes on materials that can be safely exposed to microwaves (2 words)
7. Physical method used to reduce the growth of fungi and some bacteria
9. Physical method used to kill microbes in a fluid (liquid or gas) by forcing the fluid through a material with openings that allow the fluid to pass through but are too small to allow pathogens to pass through, leaving pathogens trapped in the material
10. Physical method used to prevent microbes from reaching portals of entry
11. Physical method that will not generally kill microbes but is used to slow their growth

DOWN

1. Physical method used to kill microbes through the combined effect of heat and water that is at a temperature short of boiling (2 words)
3. Physical method used to kill microbes on materials such as plastics that cannot be subjected to high temperatures
4. Chemical method used to destroy all organisms on inanimate objects
5. Physical method used to kill all microbes and their spores through the effects of an autoclave (2 words)
6. Chemical method used to destroy bacteria on inanimate objects
7. Physical method used to kill microbes through the effects of heat from a source such as an oven or an infrared light (2 words)
8. Chemical method used to destroy bacteria on living organisms

Crossword Puzzle 10—Terms from Objectives 32 Through 35

Name ______________________________ Date ______________



ACROSS

1. Organism that presents a particular hazard for various infections to burn victims, patients with cystic fibrosis, and those patients with certain types of cancer where the skin and mucous membranes do not afford adequate protection (2 words)
7. Abbreviation for the virus responsible for AIDS
10. An inflammatory condition of the large intestine characterized by severe diarrhea, bleeding, and ulceration of the mucosa of the intestine
11. Pertaining to the intestine
12. ______ passing occurs when neither the person handing nor the person taking an object touches the object near a cutting edge (2 words)
13. Virus associated with several types of cancer, including cancers of the mouth and cervix (2 words)

DOWN

2. Organism responsible for a number of post-operative infections commonly referred to as *staph infections* (2 words)
3. The ______ species is the organism responsible for tuberculosis and leprosy and presents a particular hazard for various infections to patients with low resistance, such as those with acquired immunodeficiency syndrome (AIDS), to those receiving immunosuppressors, and to those with pulmonary conditions
4. The ______ species is the organism involved in "strep" throat, scarlett fever, pneumonia, rheumatic heart disease, and other communicable conditions
5. Organism responsible for various infections referred to as *colitis* (2 words)
6. Instruments such as scalpels, needles, tweezers, and other devices that are capable of separating flesh; also includes foreign bodies such as glass, metal fragments, splinters, knives, and other objects that may be removed from the body and then present hazards to health-care workers
8. Virus responsible for hepatitis (2 words)
9. A procedure that involves puncturing a vein

Answers to Crossword Puzzles

Crossword Puzzle 1

ACROSS

1. SYSTEMIC
5. COMMUNICABLE DISEASE
9. RESISTANCE
12. INFECTION
14. LOCALIZED
17. DISEASE

DOWN

2. SYMPTOM
3. STERILIZE
4. VIRULENCE
6. INCUBATION
7. ANTISEPTIC
8. PATHOGEN
10. DISINFECTANT
11. VACCINATION
13. TOXIN
15. ANTIBIOTIC
16. HOST

Crossword Puzzle 2

ACROSS

2. NOSOCOMIAL
7. LOCALIZED
13. ILLNESS
14. ASYMPTOMATIC
16. CARRIER
17. SECONDARY DISEASE
19. MIXED

DOWN

1. ZOONOSIS
3. SYSTEMIC
4. CONTAGIOUS
5. INCUBATION
6. LESION
8. ACUTE
9. GENITOURINARY
10. LATENT
11. CONVALESCENCE
12. CHRONIC
15. PRIMARY DISEASE
18. SPUTUM

Crossword Puzzle 3

ACROSS

2. ABILITY TO INFECT
4. SUSCEPTIBILITY
6. PROTECTIVE REFLEX
8. ANTIBODY
10. LYSOZYME
11. INVASIVENESS
13. CERUMEN

DOWN

1. FOMITE
3. BACTERIOCIDIN
5. INANIMATE
6. PHAGOCYTE
7. TOXIGENICITY
9. IMMUNITY
12. IMMUNOLOGY

Crossword Puzzle 4

ACROSS

1. SERUM PROTEIN RESPONSE
5. INFLAMMATORY REACTION
10. PASSIVE
11. VACCINE
12. INVASION
14. IMMUNE SERUM
15. PHAGOCYTOSIS
17. HISTAMINE
18. INTERFERENCE

DOWN

2. INTERFERON RESPONSE
3. GENETIC
4. SYNTHESIS
6. ACTIVE
7. ACTIVE
8. PASSIVE
9. RELEASE
13. HEPARIN
16. FIBROBLAST

Crossword Puzzle 5

ACROSS

3. MEMORY T CELLS
5. RELEASE
7. HELPER T CELLS
9. B CELL
10. ENGULFMENT
12. VACUOLE FORMATION
13. INVAGINATION
14. CYTOTOXIC T CELLS
15. SUPPRESSOR T CELLS
16. ACTIVATED B CELLS
17. MEMORY B CELLS
18. PLASMA CELLS
19. LYSOSOME

DOWN

1. T CELL
2. FUSING
4. SENSITIZED
6. SENSITIZED HELPER T CELLS
8. PSEUDOPOD
11. MARROW
13. INACTIVE B CELLS

Crossword Puzzle 6

ACROSS

1. PHAGOCYTE LOCATION
12. HUMORAL
13. SENSITIZATION
14. CLONING
15. HUMORAL MEDIATED IMMUNITY

DOWN

2. ANTIBODY PRODUCTION
3. CYTOKINE RELEASE
4. COMPLEMENT CASCADE
5. PATHOGEN BINDING
6. MACROPHAGE RESPONSE
7. MACROPHAGE RESPONSE
8. CELL MEDIATED IMMUNITY
9. SUPPRESSION
10. CLONING
11. SENSITIZATION

Crossword Puzzle 7

ACROSS

3. BARRIER FORMATION
9. CLOSELY RELATED
14. DILATION
17. PRIMARY RESPONSE

DOWN

1. SECONDARY RESPONSE
2. ATTENUATED LIVING PATHOGEN
4. ATTENUATED
5. TOXOID
6. NONPATHOGENIC STRAIN
7. HYPERSENSITIVE RESPONSE
8. LAG
9. CONSTRICTION
10. EXTRACT OF PATHOGEN
11. EXUDATION
12. KILLED PATHOGEN
13. DILATE
15. CONSTRICT
16. EXUDATE

Crossword Puzzle 8

ACROSS

3. NARROW SPECTRUM
7. MICROBIAL DEFENSE
8. ISOIMMUNITY
12. PASTEURIZATION

DOWN

1. BROAD SPECTRUM
2. IMMEDIATE
4. AUTOIMMUNITY
5. ANTISEPTIC
6. DELAYED
9. CONGENITAL
10. DISINFECTANT
11. STERILIZATION

Crossword Puzzle 9

ACROSS

2. ULTRASONIC WAVES
7. DRYING
9. FILTRATION
10. BARRIER
11. COLD

DOWN

1. MOIST HEAT
3. RADIATION
4. STERILANT
5. PRESSURIZED STEAM
6. DISINFECTANT
7. DRY HEAT
8. ANTISEPTIC

Crossword Puzzle 10

ACROSS

1. PSEUDOMONAS AERUGINOSA
7. HIV
10. COLITIS
11. ENTERIC
12. NO TOUCH
13. HUMAN PAPILLOMA

DOWN

2. STAPHYLOCOCCUS AUREUS
3. MYCOBACTERIUM
4. STREPTOCOCCUS
5. ESHERICHIA COLI
6. SHARPS
8. HEPATITIS B
9. VENIPUNCTURE

Module Review

Name ______________________________

Date ____________________ Score ____________________

DIRECTIONS Read each of the items below. From the choices given, select the response that most-correctly provides the required information. Circle the letter of the most-correct response.

Objective 1

1. A toxin is ______.
    - a. an organism that serves as a temporary home for another organism
    - b. an organism that is capable of producing disease in another
    - c. a substance that is harmful to cells
    - d. a condition that occurs in association with a disease that can be evidence of the presence of the disease

Objective 7

2. Diseases can be transmitted by ______.
    - a. living hosts only
    - b. inanimate objects or materials only
    - c. both A and B
    - d. neither A nor B

Objective 19

3. Sensitized helper T cells divide rapidly to produce ______.
    - a. memory, suppessor, and helper T cells
    - b. memory, cytotoxic, and helper B cells
    - c. memory, cytotoxic, and suppressor T cells
    - d. memory, suppressor B cells, and plasma cells

Objective 26

4. A hypersensitive response involves ______ upon exposure to a foreign substance.
    - a. an antigen/antibody reaction
    - b. an excessive response by the body's immune system
    - c. a rapid development of extremely effective antibodies
    - d. an uncontrollable motor activity by the body's immune system

Objective 33

5. Which of the following organisms is a leading cause of post-operative infections?

   a. esherichia coli

   b. bacillus anthracis

   c. clostridium tetani

   d. staphylococcus aureus

Objective 35

6. Which of the following statements is NOT a recommended practice under the CDC standard precautions?

   a. Used needles should be recapped to cover the exposed point.

   b. Staples should be used instead of sutures whenever possible.

   c. After they are used, disposable syringes and needles, scalpel blades, and other sharp items should be placed in puncture-resistant containers for disposal.

   d. Health-care workers who have sores or skin conditions that exude fluids should refrain from all direct patient care and from handling patient-care equipment until the condition resolves.

Objective 33

7. ______ is an inflammatory condition of the large intestine characterized by severe diarrhea, bleeding, and ulceration of the mucosa of the intestine.

   a. Staph infection

   b. Strep infection

   c. Colitis

   d. AIDS

Objective 13

8. Antibodies passing to a fetus through the mother's blood is characteristic of ______.

   a. naturally acquired active immunity

   b. artificially acquired active immunity

   c. both A and B

   d. neither A nor B

Objective 18

9. B cells are lymphocytes that are formed in the ______ and move to the lymph nodes and ______.

   a. fetal bone marrow, spleen

   b. fetal bone marrow, liver

   c. adult bone marrow, spleen

   d. adult bone marrow, liver

Objective 21

10. During the third stage of cell-mediated immunity development in the serum-protein response, sensitized helper T cells form other sensitized helper cells and memory, cytotoxic, and suppressor T cells. This is called the ______ *stage*.

   a. *cloning*
   b. *binding*
   c. *macrophage-response*
   d. *suppression*

Objective 35

11. Handling of body fluids and specimens should only be done while wearing goggles, masks, gloves, and ______.

   a. surgical hood
   b. surgical gowns
   c. impermeable clothing
   d. ear plugs

Objective 3

12. A special medication that slows or stops the growth of certain microorganisms is ______.

   a. a vaccination
   b. an antibiotic
   c. an antiseptic
   d. a sterilant

Objective 1

13. ______ is the presence and multiplication of an organism that results in harm or disease to a host.

   a. Immunity
   b. Immunology
   c. Infection
   d. Sanitation

Objective 6

14. Which of the following statements is NOT a normal portal of exit from the body for pathogens?

   a. skin lesions
   b. mouth
   c. intact skin
   d. genitourinary openings

Objective 15

15. ______ is a chemical that makes capillaries more permeable.

   a. Heparin
   b. Histamine
   c. Monocyte
   d. Basophil

Objective 17

16. During the ______ stage of phagocytosis, the pathogen is completely surrounded by the body of the phagocyte.

   a. invagination
   b. engulfment
   c. fusing
   d. release

Objective 19

17. Cytotoxic T cells ______ rupture the cell membrane of infected cells to prevent the pathogen from reproducing.

   a. chemically
   b. mechanically
   c. electrically
   d. sonically

Objective 24

18. During the third stage of the inflammatory reaction, the injured or infected cells secrete ______, which causes the area to swell.

   a. toxin
   b. exudate
   c. enzyme
   d. cytoplasm

Objective 34

19. Which of the following types of isolation would be recommended for a person with severe burns over a large part of her or his body?

   a. enteric
   b. total
   c. protective
   d. wound and skin

Objective 35

20. According to recommended precautions, hands should be washed ______.

    a. when needles are recapped
    b. only when venipuncture is involved
    c. immediately after gloves have been donned
    d. immediately after gloves are removed

Objective 8

21. A specialized protein produced in the blood plasma in response to bacteria, viruses, or other antigenic substances is ______.

    a. an antibody
    b. an antigen
    c. a bacteriocidin
    d. a phagocyte

Objective 2

22. The harmful effects of an infection on a host may be the direct result of an action taken by the pathogen or the result of ______ produced by the pathogen.

    a. medications
    b. vibrations
    c. leukocytes
    d. toxins

Objective 2

23. The ability of a host to avoid infection and reduce harm caused by an infecting organism is called ______.

    a. *virulence*
    b. *resistance*
    c. *dehiscence*
    d. *necrosis*

Objective 4

24. A ______ infection is one that has spread throughout a host's body from an initial site.

    a. localized
    b. systemic
    c. organic
    d. self-limiting

Objective 4

25. An infection that has no apparent symptoms is a ______ infection.

    a. chronic

    b. nosocomial

    c. latent

    d. primary-disease

Objective 5

26. The resolution of a disease can result in ______ or ______.

    a. complications, convalescence

    b. complications, symptoms

    c. convalescence, death

    d. symptoms, death

Objective 6

27. A ______ is a separation in tissue.

    a. sputum

    b. zoonose

    c. fomite

    d. lesion

Objective 9

28. The relative strength of and the amount of toxins produced by an organism is referred to as a pathogen's ______.

    a. *toxigenicity*

    b. *virulence*

    c. *resistance*

    d. *pathogenicity*

Objective 10

29. ______ provides a coating that prevents pathogens from contacting delicate areas of the skin in the ear canal.

    a. Mucus

    b. Sebum

    c. Cerumen

    d. Saliva

Objective 12

30. ______ is the study of the ways in which the body resists infection.

a. Anatomy
b. Physiology
c. Infectiology
d. Immunology

Objective 13

31. Taking antibodies from another organism as immune serum and injecting the serum into a person's bloodstream is known as ______.

a. *naturally acquired active immunity*
b. *artificially acquired active immunity*
c. both A and B
d. neither A nor B

Objective 14

32. The interferon response is the process by which a cell releases chemicals that interfere with a ______ ability to reproduce within a cell.

a. virus'
b. B cell's
c. T cell's
d. vaccine's

Objective 15

33. A type of white blood cell that, as part of the inflammatory reaction, releases chemicals that allow the capillaries to be penetrated by white blood cells and other substances that accumulate at an infection site is a ______.

a. neutrophil
b. lymphocyte
c. eosinophil
d. basophil

Objective 17

34. During phagocytosis, a lysosome fuses with the vacuole so that the contents of the lysosome are emptied into the vacuole containing the engulfed pathogen. This is called the ______ *stage* of phagocytosis.

a. *invagination*
b. *engulfment*
c. *fusing*
d. *vacuole formation*

Objective 19

35. ______ T cells suppress the immune response once a foreign antigen has been destroyed.

   a. Shutdown

   b. Suppressor

   c. Cytotoxic

   d. Memory

Objective 20

36. ______-mediated immunity relies on the ability of memory T cells to recognize a pathogen's antigen.

   a. Cell

   b. Humoral

   c. Antibody

   d. Serum

Objective 23

37. Which of the following is NOT a correct description of the antibody-production cycle that follows the body's exposure to an antigen?

   a. The lag phase is the time during which the body detects an unrecognized foreign antigen and begins to react.

   b. The primary-response phase is the phase during which the body produces antibodies that "fit" the previously unrecognized antigen.

   c. During the secondary-response phase, memory cells produce antibodies as a result of a subsequent invasion by an antigen.

   d. The tertiary-response phase involves the suppression of antibodies once immunity has developed completely.

Objective 27

38. ______ is a hypersensitive response to antigens to one's own species.

   a. Isoimmunity

   b. Autoimmunity

   c. Egosensitivity

   d. Hyposensitivity

Objective 29

39. Which of the following phrases is NOT a reason for controlling the growth of microorganisms?

a. To prevent the spread of illness

b. To produce pathogens under controlled circumstances to gain better understanding of them and to develop vaccines and other control measures for them

c. To prevent the contamination of sterile products during the production process

d. To aid in faster production processes for carbonated drinks

Objective 31

40. Which of the following is a chemical method used to destroy pathogens on a living organism?

a. cold

b. disinfectant

c. antiseptic

d. ultrasonic waves

Objective 2

41. A ______ is an organism that is capable of producing disease in another organism.

a. virulence

b. pathogen

c. toxin

d. fomite

Objective 4

42. An ______ infection is one that runs a rapid and severe course and then ends abruptly.

a. intermittent

b. elementary

c. areolar

d. acute

Objective 4

43. The first-occurring infection within a period of illness is called the ______.

a. initial infection

b. onset infection

c. primary disease

d. precursor disease

Objective 5

44. The period of time between the incidence of an infection and the appearance of symptoms in a host is referred to as the ______ *period.*

    a. *chronic*
    b. *prodromal*
    c. *acute*
    d. *incubation*

Objective 6

45. Which of the following statements is NOT a true statement about the spread of diseases?

    a. Persons who have recovered from a disease or who are asymptomatic may be carriers and transmit the disease to others.
    b. The aseptic conditions in hospitals prevent diseases from being passed from person to person.
    c. Zoonoses spread to humans from animals.
    d. Pathogens that live in the soil, on other surfaces, or in contaminated foods can also enter the body through portals of entry.

Objective 10

46. ______ combats pathogens by cleansing the pores and raising the level of acidity on the skin.

    a. Curamen
    b. Sebum
    c. Normal flora
    d. Perspiration

Objective 11

47. ______ present physical barriers to contaminated particles and help to hold mucus in place.

    a. Ciliated membranes
    b. Accessory structures
    c. Mucous glands
    d. Sinuses

Objective 11

48. ______ protect the body against infection by inhibiting the growth of bacteria in tears and saliva.

a. Endozymes

b. Exozymes

c. Lacrimozymes

d. Lysozymes

Objective 13

49. The body produces memory cells as part of ______.

a. naturally acquired active immunity

b. artificially acquired active immunity

c. both A and B

d. neither A nor B

Objective 14

50. The process by which tissues in an area of injury or infection work to trap pathogens in the localized area is called ______.

a. *interferon response*

b. *phagocytosis*

c. *serum-protein response*

d. *inflammatory reaction*

Objective 15

51. Monocytes are capable of enlarging themselves in order to perform more-rapid phagocytosis. Once enlarged, they are often referred to as ______.

a. *phagocytes*

b. *neutrophils*

c. *leukocytes*

d. *macrophages*

Objective 16

52. When the infected cell releases interferon into the bloodstream, the ______ stage of the interferon response has occurred.

a. invasion

b. synthesis

c. release

d. interference

Objective 19

53. Memory B cells remember the ______ and become involved in responding to any subsequent invasion by that pathogen.

    a. plasma cell

    b. B cells

    c. T cells

    d. antigen

Objective 21

54. In the last stage of cell-mediated immunity development in the serum-protein response, suppressor T cells secrete macrophage-inhibiting chemicals once a foreign antigen has been destroyed. This is called the ______ *stage.*

    a. *cloning*

    b. *binding*

    c. *macrophage-response*

    d. *suppression*

Objective 24

55. During the last stage of the inflammatory reaction, the secretions of the inflamed cells create a ______ that prevents pathogens from spreading from the area.

    a. chemical barrier

    b. capillary blockage

    c. polyp

    d. fibrous network

Objective 27

56. ______ is a hypersensitive response to one's own antigens.

    a. Hyposensitivity

    b. Isoimmunity

    c. Autoimmunity

    d. Egosensitivity

Objective 28

57. A chemical used to treat bacterial infections that may be caused by a wide variety of bacteria is called a ______.

    a. *narrow-spectrum antibiotic*

    b. *broad-spectrum antibiotic*

    c. *nonspecific bacteriocidin*

    d. *specific bacteriocidin*

Objective 32

58. Which of the following phrases is NOT a factor that normally contributes to nosocomial infections?

   a. a false sense of security

   b. facility staffing

   c. improper hand-washing techniques

   d. aseptic procedures

Objective 35

59. Hands and other skin surfaces should be ______ immediately and thoroughly if contaminated with blood or other body fluids.

   a. washed

   b. disinfected

   c. sterilized

   d. injected with antibiotics

Objective 35

60. According to recommended precautions, used ______ should be placed in disposable containers, using no-touch passing.

   a. tape

   b. sharps

   c. sutures

   d. medicine bottles

Objective 2

61. A condition, such as fever, chills, and loss of appetite, that occurs in association with a disease is a ______.

   a. leukocyte

   b. toxin

   c. symptom

   d. infecting organism

Objective 2

62. The ability of an infecting organism to harm a host is referred to as ______.

   a. *virulence*

   b. *resistance*

   c. *dehiscence*

   d. *necrosis*

Objective 3

63. Some infections can be prevented through ______.

a. vaccinations
b. incubation
c. contamination
d. eventration

Objective 4

64. A ______ infection results from more than one organism.

a. parapathogenic
b. multi-phasic
c. secondary disease
d. mixed

Objective 6

65. Typically, a disease will spread from an infected host's portals of ______ to a second host's portals of ______.

a. entry, exit
b. exit, entry
c. either A or B
d. neither A nor B

Objective 6

66. Which of the following is NOT a normal portal of entry into the body for pathogens?

a. breaks in the skin
b. nose
c. intact skin
d. genitourinary openings

Objective 8

67. Which of the following is NOT a factor in determining whether a pathogen will cause a disease in a host's body?

a. antigens
b. site of the pathogen invasion
c. antibacterial techniques
d. normal flora

Objective 10

68. Tears combat pathogens by ______.

a. ridding the eyes of contaminants and helping to seal and lubricate the eyelids to prevent entry of organisms

b. containing enzymes that help break down invading pathogens and prevent them from colonizing on the eyelids

c. maintaining a slightly acidic environment to prevent microorganisms from becoming established on the eyelids

d. providing a coating that prevents pathogens from making direct contact with the eyes

Objective 13

69. Genetic immunity is based on ______.

a. one's inherited genetic makeup

b. the pathogen's genetic makeup

c. the production of antibodies

d. vaccinations

Objective 13

70. When an individual is given a vaccine, her or his body produces antibodies in response to the pathogen. This is a characteristic of ______.

a. naturally acquired active immunity

b. artificially acquired active immunity

c. both A and B

d. neither A nor B

Objective 14

71. The process by which components of the blood and lymph analyze captured pathogens to help develop immunity reactions to the pathogens is called ______.

a. *interferon response*

b. *phagocytosis*

c. *serum-protein response*

d. *inflammatory reaction*

Objective 16

72. Which of the following is the correct sequence of the interferon response?

a. invasion, synthesis, release, phagocytosis, interference

b. invasion, synthesis, release, interference, phagocytosis

c. synthesis, invasion, release, interference, phagocytosis

d. synthesis, invasion, release, interference, phagocytosis

Objective 18

73. T cells are lymphocytes that are formed in either the ______ and pass through the ______ on the way to the lymph nodes and ______.

    a. fetal thymus gland or in the bone marrow, thymus, liver

    b. fetal thymus gland or in the bone marrow, thymus, spleen

    c. adult bone marrow, thymus, liver

    d. adult bone marrow, thymus, spleen

Objective 19

74. Cytotoxic T cells produce cytokines that ______.

    a. kill pathogens

    b. produce phagocytes

    c. develop into memory T cells

    d. attract phagocytes to the area where the pathogen is located

Objective 22

75. During the antibody-production stage of humoral-mediated immunity development, the plasma cells produce antibodies specific to a pathogen's ______ and tag the pathogen cells for destruction by phagocytes.

    a. B cells

    b. plasma cells

    c. antigen

    d. enzymes

Objective 22

76. Which of the following statements describes the complement-cascade stage of humoral-mediated immunity development?

    a. Helper T cells present the pathogen antigen to B cells, which become sensitized to the antigen.

    b. The B cells form memory B cells and plasma cells.

    c. Macrophages migrate to the infection site and engulf pathogens and damaged cells.

    d. Enzymes in the plasma cause a chain of chemical reactions that result in the components rupturing pathogen cells and in other actions such as attracting neutrophils to the site.

Objective 25

77. A vaccine that contains organisms of the same genus as the target pathogen but that are a species or subspecies that is not pathogenic is called a ______ *vaccine.*

a. *closely-related-microorganism*

b. *nonpathogenic-strain*

c. *attenuated, living-pathogen*

d. *killed-pathogen*

Objective 30

78. Which of the following phrases is NOT a factor in determining the effectiveness of an antimicrobial procedure?

a. the immediacy of the initial treatment

b. the concentration or strength of the antimicrobial substance used in the procedure

c. the type and number of microbe

d. portal of exit and whether or not the procedure includes prescription drugs

Objective 34

79. ______ isolation is a type of isolation that requires the use of a mask and separation of a patient from contact with other patients.

a. Enteric

b. Total

c. Respiratory

d. Wound and skin

Objective 33

80. Which of the following organisms is responsible for AIDS?

a. human papilloma virus

b. human immunodeficiency virus

c. pseudomonas aeruginosa

d. mycobacterium species

Objective 2

81. ______ diseases can spread from one human host to another through direct or indirect contact.

a. Communicable

b. Congenital

c. Immunological

d. Aseptic

Objective 4

82. An infection that is limited to one organ or site of a host's body is said to be ______.

    a. *localized*

    b. *systemic*

    c. *organic*

    d. *self-limiting*

Objective 4

83. An infection that is contracted in a hospital or other health-care facility, such as a nursing home, is a ______ infection.

    a. chronic

    b. nosocomial

    c. latent

    d. primary-disease

Objective 5

84. The period of time during which a host exhibits symptoms of a disease is called the ______ *phase* in the course of a disease.

    a. *recuperation*

    b. *histological*

    c. *resident*

    d. *illness*

Objective 9

85. An organism's ______ are two factors that influence a pathogen's virulence.

    a. size and shape

    b. ability to infect and invasiveness

    c. age and health

    d. phagocytosis and mobility

Objective 10

86. ______ compete with invading microorganisms to prevent them from becoming established.

    a. Secondary infectious pathogens

    b. Normal flora

    c. Vectors of disease

    d. Parasitic arthropods

Objective 11

87. Removal of pathogens through the movement of liquids is referred to as ______.

    a. *purging*
    b. *protective reflex*
    c. *flushing actions*
    d. *peristalsis*

Objective 13

88. When an individual contracts a disease, his or her body naturally produces ______ in response to the pathogen.

    a. antigens
    b. antibodies
    c. vaccines
    d. serum

Objective 13

89. ______ is taken from another organism and contains antibodies against a specific disease.

    a. Cerumen
    b. An immune serum
    c. A vaccine
    d. Interferon

Objective 15

90. A type of white blood cell that is the first to respond to an inflammatory reaction, where it performs phagocytosis on pathogens is a ______.

    a. neutrophil
    b. lymphocyte
    c. eosinophil
    d. basophil

Objective 19

91. ______ produce antibodies specific to a pathogen's antigen and tag the pathogen cells for destruction by phagocytes.

    a. Plasma cells
    b. Memory cells
    c. Antibodies
    d. Lymphocytes

Objective 25

92. A vaccine that contains bacterial capsules of a pathogen is referred to as an ______ *vaccine.*

    a. *encapsulated*

    b. *toxoid*

    c. *extract-of-pathogen*

    d. *attenuated*

Objective 28

93. A process that destroys pathogens on surfaces is called ______.

    a. *sanitation*

    b. *aseptics*

    c. *pasteurization*

    d. *sterilization*

Objective 31

94. Which of the following is the most-effective method of controlling all microbial growth on scalpels?

    a. cold

    b. dry heat

    c. moist heat

    d. pressurized steam

Objective 33

95. ______ is an organism that presents a particular hazard for various infections to burn victims, patients with cystic fibrosis, and those patients with certain types of cancer where the skin and mucous membranes do not afford adequate protection.

    a. Human papilloma virus

    b. Human immunodeficiency virus

    c. Pseudomonas aeruginosa

    d. Mycobacterium species

Objective 9

96. ______ is the state of being protected from the effects of a pathogen.

    a. Susceptibility

    b. Immunity

    c. Invasiveness

    d. Toxigenicity

Objective 2

97. The body produces special cells that recognize pathogens and ______.

a. avoid them

b. escort them from the body

c. destroy them

d. increase their rate of reproduction

Objectives 2 & 3

98. Which of the following statements is NOT correct with regard to infections.

a. An infection may result in observable symptoms in a host, or the infection may occur without symptoms.

b. Once an infection has occurred, there is no way to improve the body's ability to fight the infection.

c. An infection may be localized or systemic.

d. The spread of infection can be reduced by using antiseptic practices, cleaning with disinfectants, and sterilizing instruments and surgical materials.

Objective 4

99. An infection that lasts for a long period of time—from weeks to several years—is called a ______ *infection.*

a. *chronic*

b. *nosocomial*

c. *latent*

d. *primary disease*

Objective 4

100. A subsequent infection or complication to an existing condition is called a ______.

a. *recurring illness*

b. *chronic illness*

c. *secondary disease*

d. *postoperative disease*

Objective 7

101. An inanimate object that is contaminated with pathogens and is capable of transmitting pathogens to a human host is a ______.

a. lesion

b. zoonose

c. fomite

d. toxin

Objective 11

102. A ______ reflex generally expels contaminated substances from the body.

   a. purging
   b. protective
   c. flushing
   d. peristalsis

Objective 14

103. The process in which a moving cell engulfs a mass of foreign material is called ______.

   a. *monocytal ingestion*
   b. *phagocytosis*
   c. *passive immunity*
   d. *pincocytosis*

Objective 28

104. A chemical used to destroy or reduce the growth of pathogens on people is called ______.

   a. an *antiseptic*
   b. a *disinfectant*
   c. an *aseptic*
   d. a *dessicant*

Objective 31

105. The use of a face shield to prevent microbes from reaching portals of entry is referred to as a ______.

   a. *barrier*
   b. *filtration*
   c. *sterilization*
   d. *disinfectant*

Answers to Module Review

1. c
2. c
3. c
4. b
5. d
6. a
7. c
8. d
9. a
10. a
11. c
12. b
13. c
14. c
15. b
16. b
17. a
18. b
19. d
20. d
21. a
22. d
23. b
24. b
25. c
26. c
27. d
28. a
29. c
30. d
31. b
32. a
33. d
34. c
35. b
36. a
37. d
38. a
39. d
40. c
41. b
42. d
43. c
44. d
45. b
46. d
47. a
48. d
49. c
50. d
51. d
52. c
53. d
54. d
55. d
56. c
57. b
58. d
59. a
60. b
61. c
62. a
63. a
64. d
65. b
66. c
67. a
68. a
69. a
70. b
71. c
72. b
73. b
74. d
75. c
76. d
77. b
78. d
79. c
80. b
81. a
82. a
83. b
84. d
85. b
86. b
87. c
88. b
89. b
90. a
91. a
92. c
93. d
94. d
95. c
96. b
97. c
98. b
99. a
100. c
101. c
102. b
103. b
104. a
105. a

MODULE SET I: Introduction to Anatomy and Physiology

Module 4: Tissues, Membranes, and Wound Healing

Module Set I: Introduction to Anatomy and Physiology
Module 4: Tissues, Membranes, and Wound Healing

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Suggested Activities

INSTRUCTIONAL PLAN

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

PREPARATION

- Review the module in the student edition.
- Review the Teaching Suggestions section that follows on page 4 of the Suggested Activities.
- Review the Resources Used in Developing This Module section that follows on page 5 of the Suggested Activities.
- Review the Suggested Web Sites section that follows on page 6 of the Suggested Activities.
- Review the additional resources that follow: transparency masters, Written Test, crossword puzzles, and Module Review.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Make transparencies from the transparency masters.
- Select web sites to be inserted on the Learning Activities Sheet in the student edition.
- Select additional activities to be inserted on the Learning Activities Sheet in the student edition.
- Copy the Written Test, crossword puzzles, and Module Review for distribution to your students.
- Prepare supplemental resources for use by your students.

DELIVERY AND APPLICATION

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.

EVALUATION

- Give the Written Test. Reteach and retest as required.
- Review with students the remaining component in the student edition: the assignment sheet.

- Have students complete the assignment sheet.
- Give the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Reteach and retest as required.

TEACHING SUGGESTIONS

✔ **NOTE:** This module has two primary purposes: to introduce students to the basic types of tissues and membranes and to the wound-healing processes in the human body. Look for opportunities to reinforce both goals as you present the module.

- Use crossword puzzles 1 through 8 to help reinforce the terms in the associated objectives.
- For Objectives 1 through 13, use the following strategies for tissue types.
    - Obtain or prepare slides of the various types of tissues. Discuss the structure and anatomical locations of each. Once the students are familiar with the types of tissues, provide them with slides to identify tissues by their appearance or use photos from histological catalogs.
    - Have students discuss how the structures of various types of tissues support their functions.
    - Have students scrape epithelial cells from the insides of their cheeks and examine them under microscopes. Stain the cells if desired.
    - Relate types of tissues to cuts of meat. For example, show marbling, muscle, tendons and ligaments, and other structures that can be used to illustrate various types of tissue.
    - Demonstrate nerve response using electrodes and dissection subjects if used in your program.
    - Provide the class with samples of the various types of muscle tissue using cuts of meats and animal hearts. Have the student identify types of muscle tissue from samples. Relate the structure of the tissues to muscle function and skeletal connections.
- For Objectives 14 through 16, demonstrate types of muscle contractions and relate these actions to the functioning of nerve tissues and the concept of *neuromuscular excitability*.
- For Objectives 17 and 18, obtain samples of each type of membrane as well as illustrations of human membranes of the same types. At this point it will be possible to discuss with students evolutionary differences in tissues and membranes. For example, bones in mammals, birds, and fish are very different though all are types of connective tissue.
- In discussing Objectives 19 and 20, relate kinds of tissue and membranes to specific organs. Provide slides, photographs, or other illustrations to assist with the discussion.

Use full anatomical views or models such as a Visible Man/Visible Woman to have the students identify organs and structures being discussed.

- Discuss a couple of organs, such as the heart or kidneys, and relate the statements in Objective 21 to the structure and functioning of the organ so that students can relate system functioning to actual organs. For example, discuss the types of tissues that make up the organ, how the organ contributes to homeostasis, how the organ is involved in the monitoring of internal and/or external conditions, etc. Remind students that these aspects of organ systems will be discussed in detail in later modules so that the students will gain an in-depth understanding of the roles of specific organs and organ systems.
- Expand Objective 22 by providing examples and illustrations of the various types of abnormalities. Discuss cancers and tumors and the latest theories of cancer development.
- To supplement your discussion of Objectives 23 and 24, provide illustrations of types of tissue injuries and types of traumatic wounds. Visit a care facility to observe these types of injuries if appropriate for your program and students. Discuss the potential severeity and treatment for these types of injuries and traumatic wounds, especially where surgery may be required.
- For Objective 25, build on the students' understanding of the inflammation response to discuss tissue involvement in creating the response.
- To supplement your discussion of Objective 26, provide the students with illustrations of the stages of healing. Discuss each stage: what is happening in the body as a result of the healing process.
- In discussing Objective 27, concerning the levels of intention as they relate to healing, help the students to understand that these levels of treatment may be unavoidable. For example, if an injury requiring sutures cannot receive immediate medical attention, the healing process will begin without the assistance that surgical intervention can provide. After a certain point, the level of treatment must be assessed in terms of the healing that has taken place—that is, if suturing is eventually available, will the healing be enhanced or harmfully interrupted by surgical intervention. Also discuss medically maintained openings such as tracheotomies, colostomies, and iliostomies.
- Use case studies of actual patient histories to supplement your discussion of Objectives 28 and 29, which concern the factors that affect the wound-healing process and the factors that present possible complications to the wound-healing process.
- Objective 30 provides statistical information about classes of surgical wounds. Modify the material as necessary to be consistent with the terminology and criteria used in your facility. Discuss expected infection rates and reasons for the increased risk with higher classifications of surgical wounds. Discuss reasons that may necessitate performing procedures under less-than-ideal conditions. Provide illustrations of the various classes of surgical wounds.

RESOURCES USED IN DEVELOPING THIS MODULE

- *Anatomy and Physiology.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1993.
- *Core Curriculum for Surgical Technology,* 4th ed. Englewood, CO: Association of Surgical Technologists, Inc., 1996.

- Gylys, Barbara A., and Regina Masters. *Medical Terminology Simplified*, 2nd ed. Philadelphia: F.A. Davis Company, 1998.
- Gray, Henry. *Gray's Anatomy*, 15th ed. New York: Gramery Books, 1977.
- Kwon-Chung, K. J., and John E. Bennett. *Medical Mycology.* Philadelphia: Lea and Febiger, 1992.
- Scanlon, Valerie C. *Essentials of Anatomy and Physiology*, 3rd ed. Philadelphia: F.A. Davis Company, 1999.
- Sherris, David A., and Eugene B. Kern. *Basic Surgical Skills.* Rochester, MN: Mayo Foundation for Medical Education and Research, 1999.
- Thibodeau, Gary A., and Kevin T. Patton. *Anatomy and Physiology*, 4th ed. St. Louis: Mosby, Inc., 1999.

SUGGESTED WEB SITES*

✔ **NOTE:** The following web sites offer general information about anatomy and physiology and generally cover more than one body system. Later modules list sites specific to the systems and disorders presented in that module. These sites can be used in a general way with the first four modules included in Module Set I and for specific portions of the sites as they relate to the systems covered in later modules in Module Set II.

- http://harveyproject.org

  The Harvey Project is an international collaboration of educators, researchers, physicians, students, programmers, instructional designers, and graphic artists working together to build interactive, dynamic human physiology course materials on the WWW. Materials produced by the Harvey Project are available free to educational institutions. The site is constantly updated and should be checked often and browsed for overall content. The address provided is for the home page. By clicking the WEB button, you will be taken to an index of links divided into categories such as general physiology and specific systems. The number of links in each category is indicated in parentheses after the topic.

- http://www.hapsweb.org/

  The Human Anatomy and Physiology Society (HAPS) was founded to promote communications among teachers of human anatomy and physiology in colleges, universities, and related institutions; to present workshops and conferences where members can obtain information about the latest developments in the health and sciences fields; and to encourage educational research and publication by HAPS members. The site contains information about society resources, including a newsletter, publications, and resources on the World Wide Web.

- http://www.niagra.edu/~bcliff/hapcstop.html

  This site contains case studies for all AST subject areas. The case studies are free to use as long as their source is acknowledged.

- http://www.nim.nih.gov/research/visible/visible_human.html

  The Visible Human Project's objective is to create complete, anatomically detailed, three-dimensional representations of the normal male and female human bodies. The site contains CT, MR, and cryosection images of male and female cadavers. The male is sectioned at one-millimeter intervals, while the female is sectioned at one-third-of-a-millimeter intervals.

- http://edtech.nepean.uws.edu.au/science/ap/index.html

  This anatomy and physiology resource page contains information, images, suggestions, tips, and stimuli to students preparing for a career in health services. Although based on Australian requirements, much of the information is useful for students in other nations.

- http://www.innerbody.com/htm/body.html

  This site provides a great deal of information on the human body in fun, interactive formats. There is a great deal of emphasis on terminology and body parts.

- http://www.orthop.washington.edu/Bone%20and%20Sources/Sources.idx.html

  Sponsored by the University of Washington, this site offers information on orthopedic-related subjects and links to similar sites.

- http://tray.dermatology.uiowa.edu/DermImag.htm

  This site offers many images of the skin and underlying tissues.

- http://www.ctru.auckland.ac.nz/atlas/intro/cardiac.htm

  This site offers an atlas that provides nearly 100 cross-sectional views of the cardiac anatomy created with an MRI scanner. The views are labeled and taken along different axes.

- http://www.prenhall.com/martini/

  This site is geared to five Prentice-Hall textbooks and offers a variety of self-grading quizzes, links to other web sites, a forum for student discussion, and other resources.

- http://www.heartsite.com/index.html

  Although designed for patients with heart-related complaints, this site contains a great deal of information about the heart and its disorders.

- http://www.merck.com/health/

  This site provides a general guide to health that addresses many of the disorders covered in this curriculum.

- http://www-sci.lib.uci.edu/~martindale/MedicalAnatomy.html

  This site provides a wealth of information and many useful graphics about human anatomy.

- http://www.uchsc.edu/sm/chs/gallery/gallery.htm

  This link goes directly to the gallery portion of the Visible Body Project at the University of Colorado.

- http://sln.fi.edu/biosci/biosci.html

  This site allows students to explore the heart, its structure and development, the flow of blood, and its relationship to other body systems. It also presents information about heart health and the history of heart science.

- http://www.maui.net/~jms/brainuse.html

  This site deals primarily with the brain and offers many useful graphics.

- http://www.cid.ch/DAVID/Mainmenu.html

  This is a rich gallery of CAT scans that can be explored through links to various sections of the body.

- http://www.meddean.luc/lumen/MedEd/GrossAnatomy/GA.html

  This site provides many images that include laboratory slides and anatomical cross-sections.

- http://www.med.umich.edu/lrc/Atlas/atlas.html

  ATLAS-plus integrates the use of digitized images, computer graphics, sound, animations, and textual information to teach basic concepts and principles of human anatomy through three courses: gross anatomy, histology, and embryology. The gross-anatomy course includes systemic components and dissection images.

- http://www.rad.washington.edu/anatomy/index.html

  This site features radiological images of the body and the skeletal system.

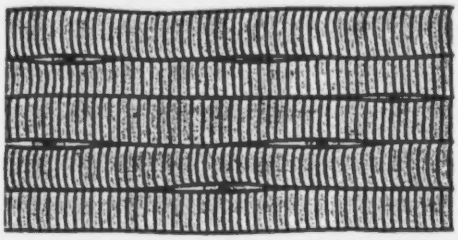
- http://www9.biostr.washingron.edu/da.html

  This site provides images and information in four areas: the brain, neuroanatomy, thoracic viscera, and the knee.

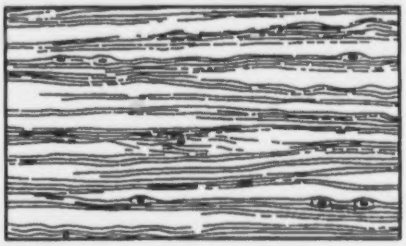
*Web-site addresses were accurate and all content on referenced web sites was appropriate during development and production of this product. However, web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all web sites prior to use.

Module Set I: Introduction to Anatomy and Physiology
Module 4: Tissues, Membranes, and Wound Healing

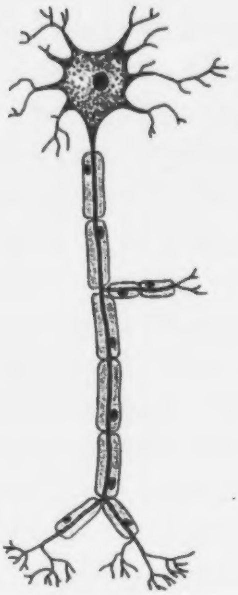
Basic Types of Tissue



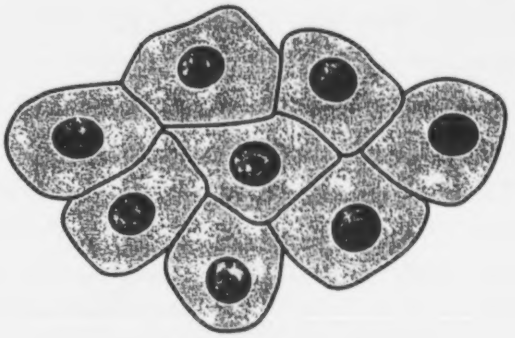
Muscle tissue
(skeletal muscle tissue)



Connective tissue
(fibrous tissue)

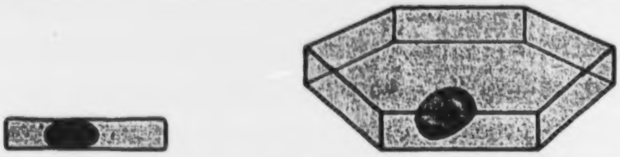


Nerve tissue
(neuron)

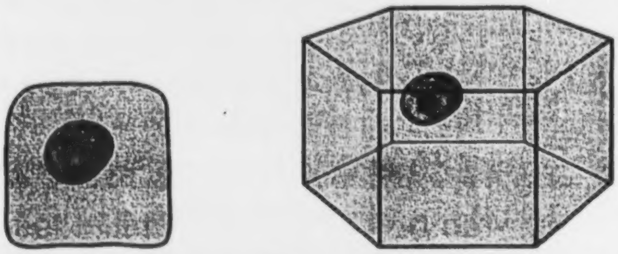


Epithelial tissue
(surface view)

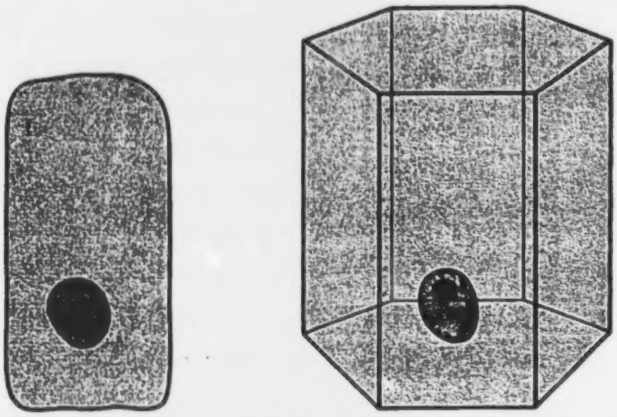
Types of Epithelial Tissue as Classified by Shape


Side view
Three-dimensional view

Squamous cell

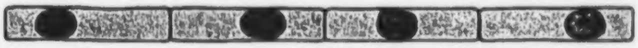

Side view
Three-dimensional view

Cuboidal cell

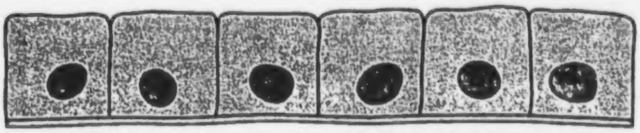

Side view
Three-dimensional view

Columnar cell

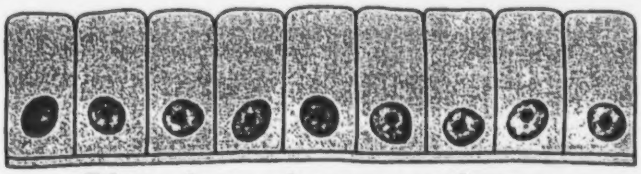
Types of Epithelial Tissue as Classified by Tissue-Layer Arrangement



Simple squamous tissue

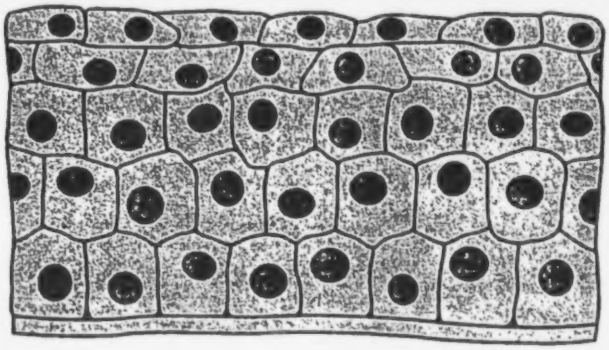


Simple cuboidal tissue



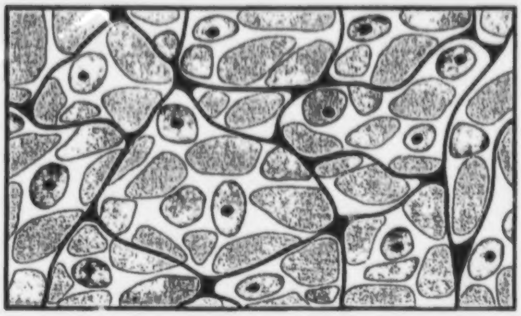
Simple columnar tissue

Simple tissue-layer arrangement

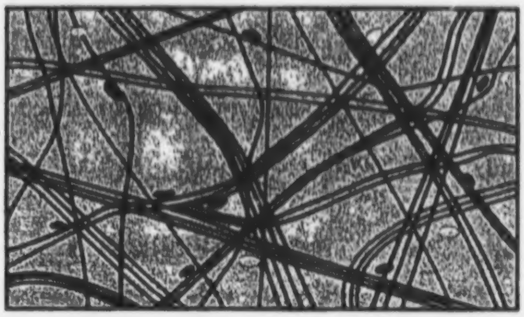


Stratified tissue-layer arrangement

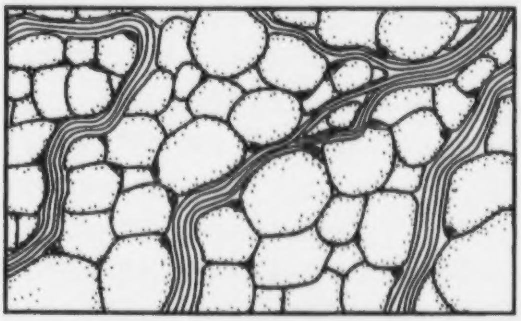
Types of Connective Tissue



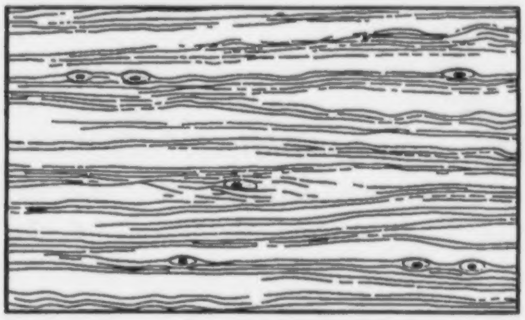
Reticular tissue



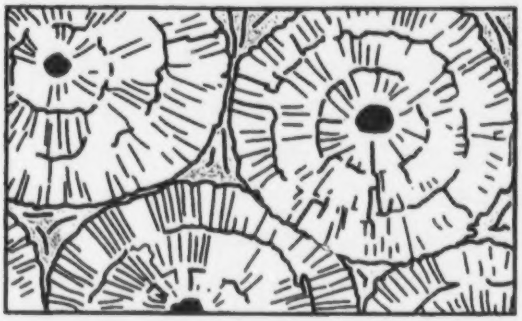
Areolar tissue



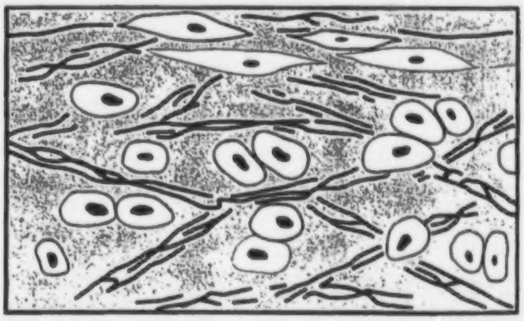
Adipose tissue



Fibrous tissue

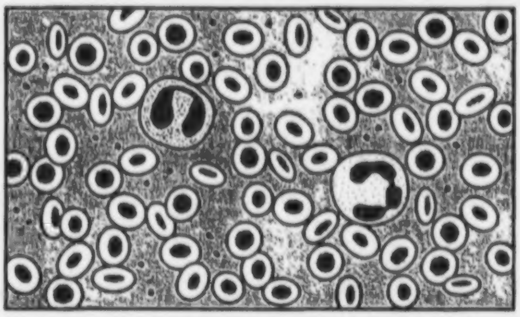


Bone tissue

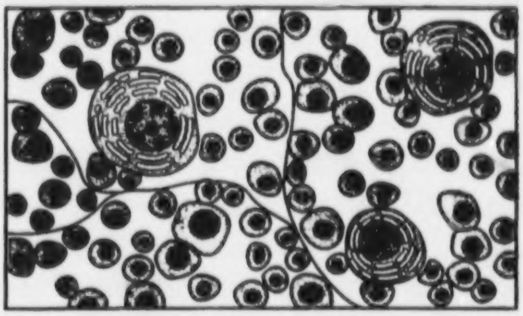


Cartilage tissue

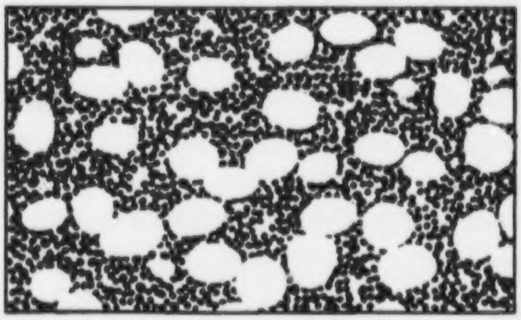
Types of Connective Tissue (cont.)



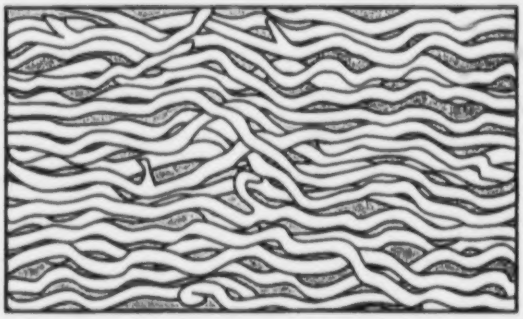
Blood tissue



Lymphatic tissue

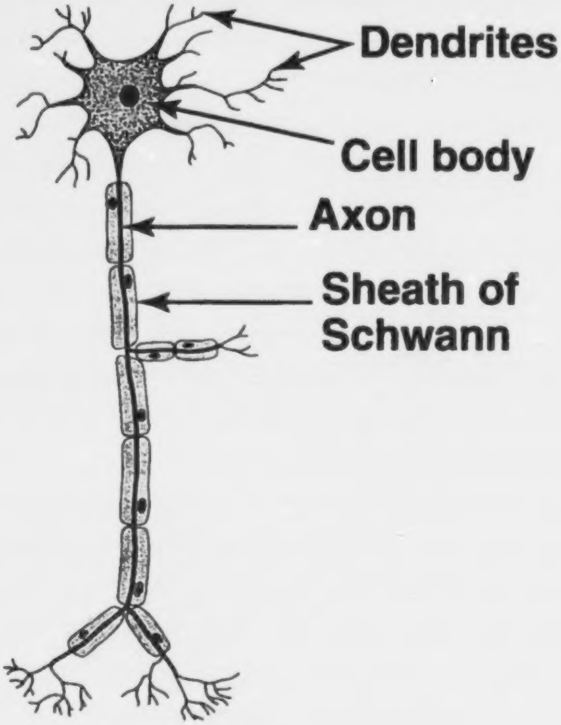


Myeloid tissue

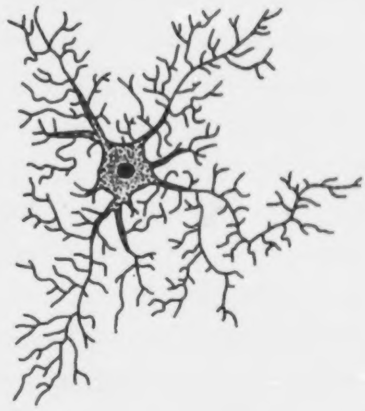


Elastic tissue

Basic Types of Nerve Tissue

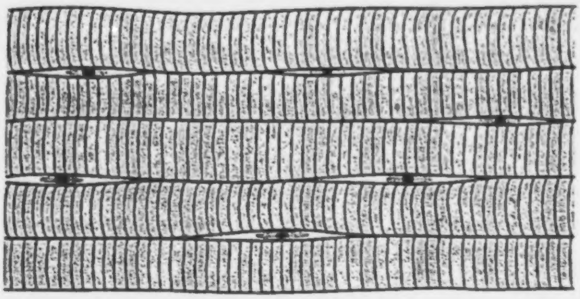

Dendrites
Cell body
Axon
Sheath of Schwann

Neuron

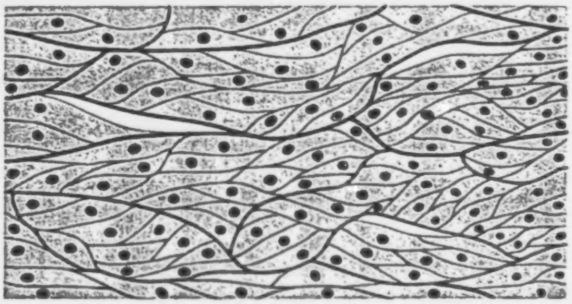


Neuroglia

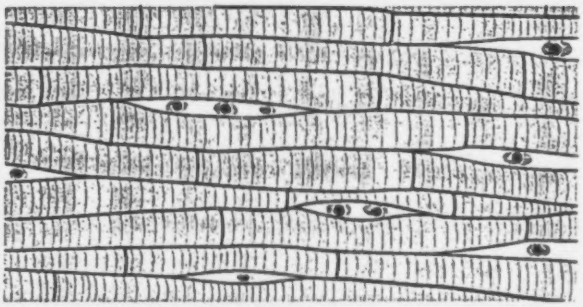
Types of Muscle Tissue



Skeletal muscle tissue
(striated tissue)

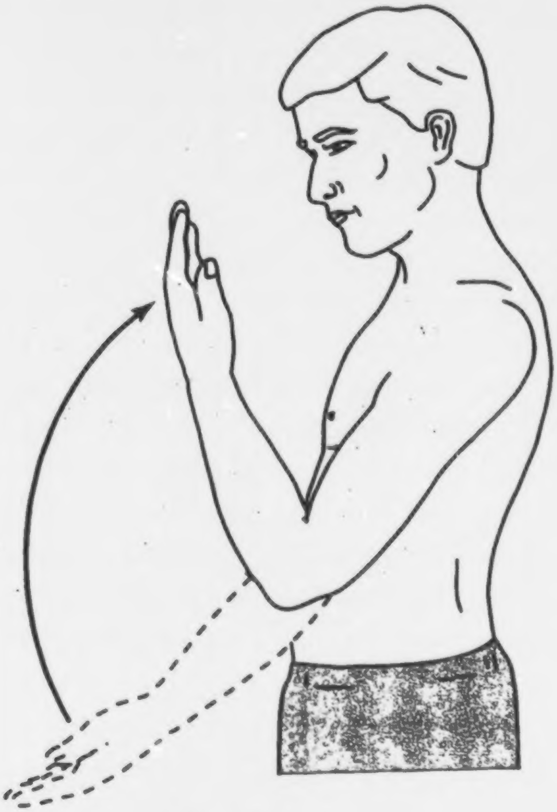


Visceral muscle tissue
(smooth tissue)

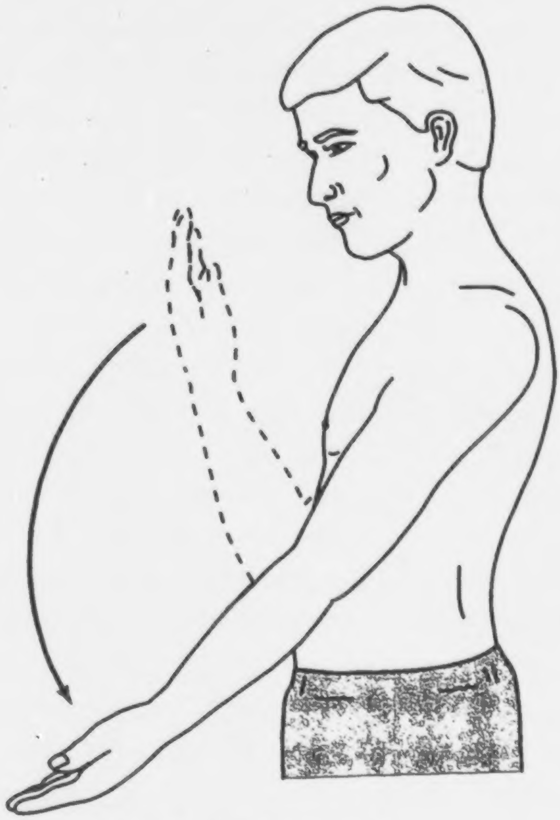


Cardiac muscle tissue
(striated tissue)

Types of Muscle Contractions

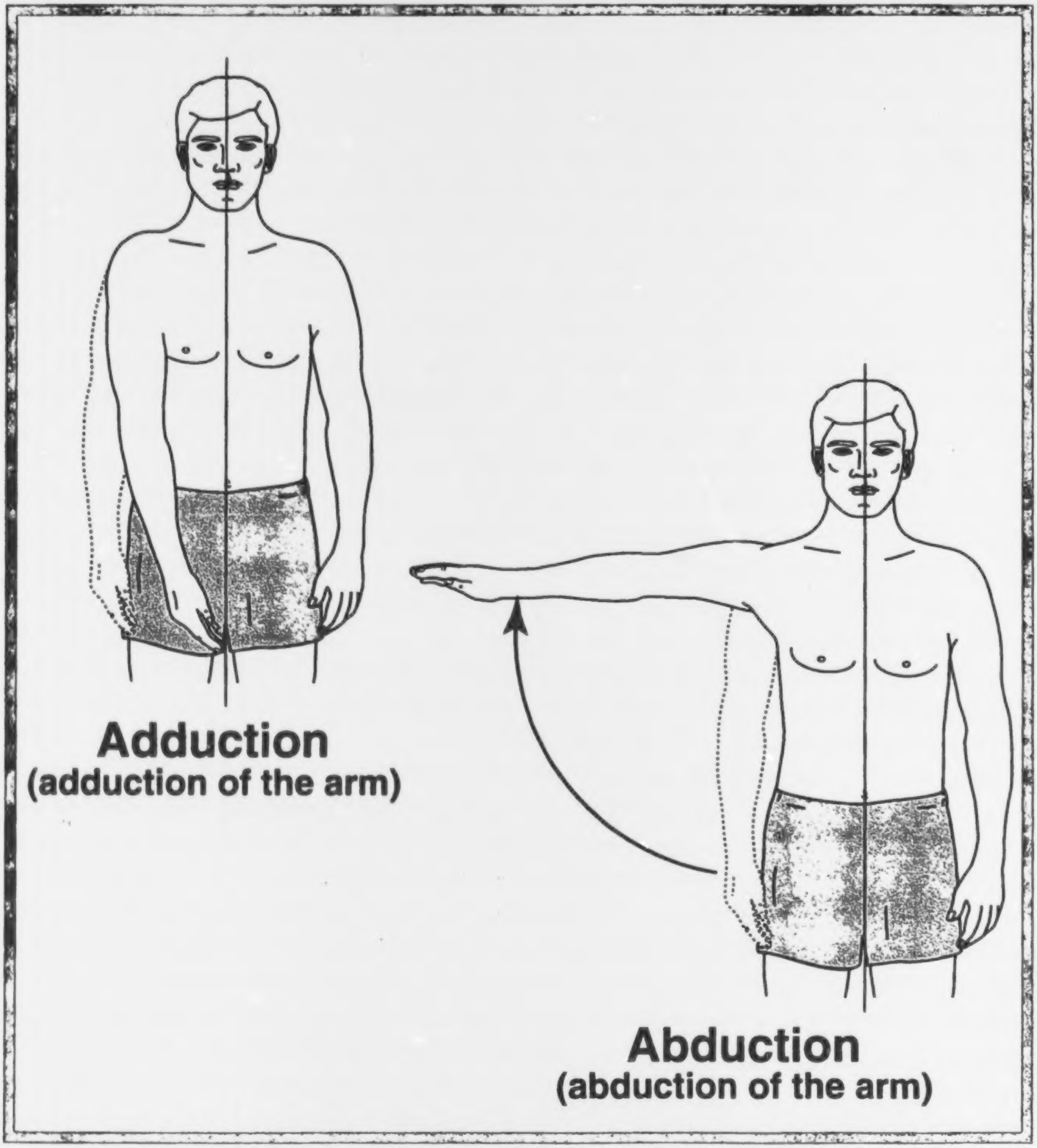


Flexion
(flexion of the elbow)

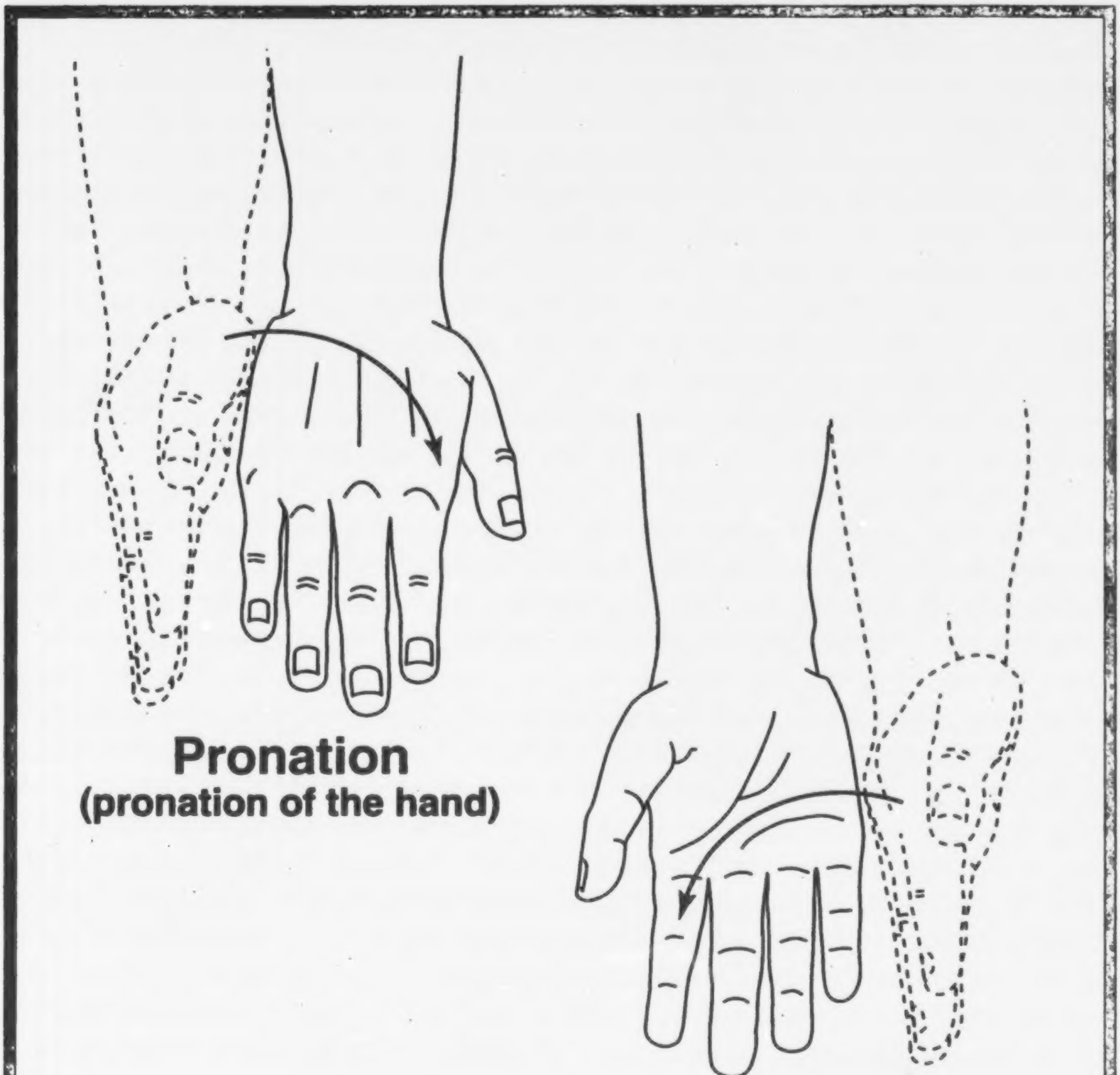


Extension
(extension of the elbow)

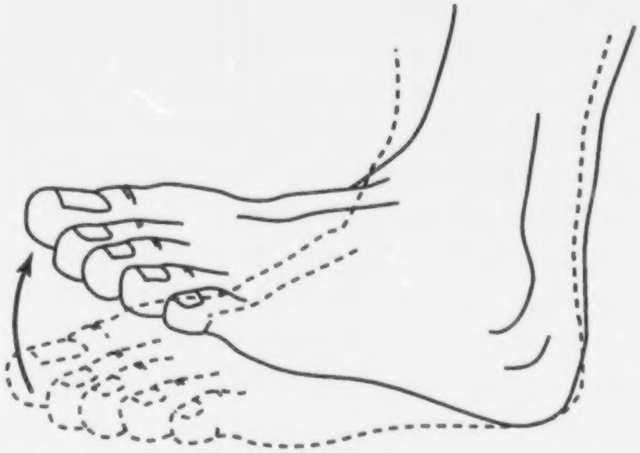
Types of Muscle Contractions (cont.)


Adduction
(adduction of the arm)
Abduction
(abduction of the arm)

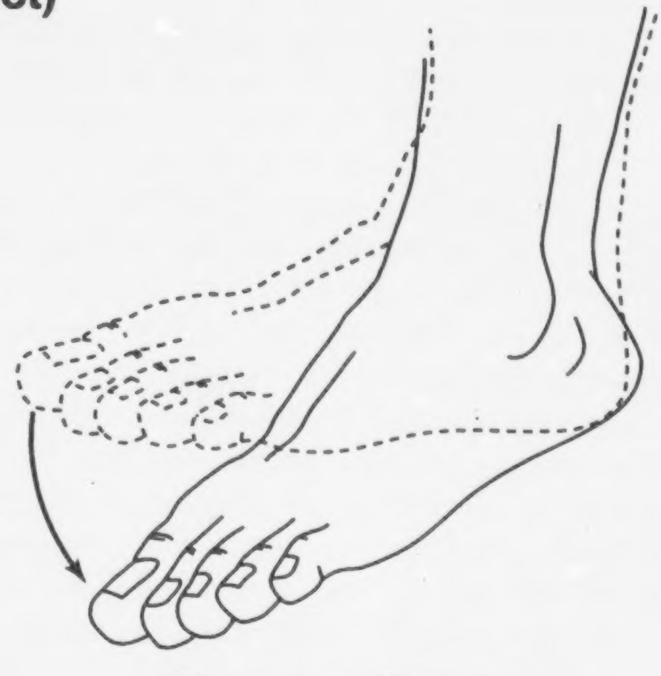
Types of Muscle Contractions (cont.)


Pronation
(pronation of the hand)
Supination
(supination of the hand)

Types of Muscle Contractions (cont.)

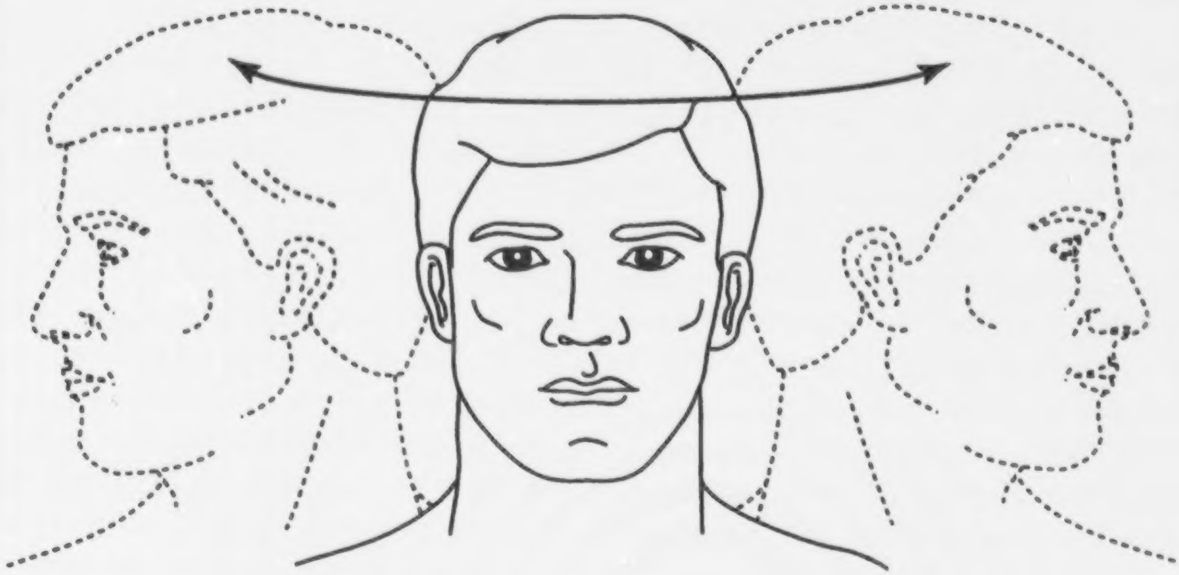


Dorsiflexion
(dorsiflexion of the foot)



Plantar flexion

Types of Muscle Contractions (cont.)



Rotation
(rotation of the head)

Written Test

Name ____

Date ______________________ Score ______________________

OBJECTIVE 1

Define the term *tissue*. Write your answer on the blank lines provided beside the term below.

Tissue ____

____

OBJECTIVE 2

Match the basic types of tissue to their correct descriptions. Write the numbers on the blanks provided.

1. Connective tissue
2. Epithelial tissue
3. Muscle tissue
4. Nerve tissue

_______ a. Tissue composed of fibers that are able to contract, causing and allowing movement of the parts and organs of the body

_______ b. Tissue consisting of one or more bundles of impulse-carrying fibers that connect the brain and the spinal cord with other parts of the body

_______ c. Tissue consisting of cells bound by connective material and varying in the number of layers and in the kinds of cells

_______ d. Dense tissue containing large numbers of cells and large amounts of intercellular material composed of fibers in a matrix or ground substance that may be liquid, gelatinous, or solid

OBJECTIVE 3

State the functions of the basic types of tissue. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Epithelial tissue ____

____

b. Connective tissue ____

____

c. Muscle tissue ____

____

d. Nerve tissue ____

____

OBJECTIVE 4 Complete statements that describe the characteristics of the epithelium. Write your answers on the blank lines provided in the statements below.

a. The epithelium covers the __________________ and many of its __________________.

b. The epithelium lines the body's __________________ cavities; __________________ and __________________ vessels; and the __________________, __________________, and __________________ tracts.

c. The body's __________________ consist of epithelial tissue.

d. Cells that compose the epithelium are compactly arranged with little __________________ substance.

e. The epithelium always rests on a layer of connective tissue with a ______________________________ between them.

f. There are no __________________ within the epithelium, which means that oxygen and nutrients must be provided by the underlying connective tissue through diffusion.

g. Epithelial cells undergo constant __________________ in order to replace the outer-layer cells that are lost through wear and exposure to forces and the environment.

OBJECTIVE 5 Define the types of epithelial tissue as classified by shape. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Squamous tissue ____

____

____

____

b. Cuboidal tissue ____

____

____

____

c. Columnar tissue ________________

OBJECTIVE 6 Define the types of epithelial tissue as classified by tissue-layer arrangement. Write your answers on the blank lines provided beside each of the terms below.

a. Simple tissue ________________

b. Stratified tissue ________________

OBJECTIVE 7 Match the classes of epithelial tissue to their correct functions. Write the numbers on the blanks provided.

1. Columnar tissue
2. Cuboidal tissue
3. Simple tissue
4. Squamous tissue
5. Stratified tissue

________ a. Lines glands such as the thyroid and salivary glands; the shape of the tissue promotes secretion of chemicals by the glands

________ b. Forms the outer layer of the skin and the lining of the esophagus and the vagina; the thickness of the tissue and its secretions help to protect the body against pathogens

________ c. Lines the stomach and intestines and secretes gastric juices and enzymes; some have cilia to sweep substances along, such as those that line the fallopian tubes and move an ovum toward the uterus

________ d. Lines the blood vessels and the alveoli; the thinness of the tissue allows gases and chemicals to pass through the tissue

________ e. Forms the single-layer linings of the capillaries, the thyroid gland, and the stomach; the thinness of the tissue allows gases and other substances to go in and out through the tissue

OBJECTIVE 8 Match the types of connective tissue to their correct functions. Write the numbers on the blanks provided.

1. Adipose tissue
2. Areolar tissue
3. Blood tissue
4. Bone tissue
5. Cartilage tissue
6. Elastic tissue
7. Fibrous tissue
8. Lymphatic tissue
9. Myeloid tissue
10. Reticular tissue

______ a. Located in the skeleton; forms bones to support the body and protect organs and tissues

______ b. Located in tendons, ligaments, deep fascia, dermis, and the kidneys; provides strong, flexible connections and the formation of scars

______ c. Located in the bone marrow; forms red and white blood cells and platelets

______ d. Located in the spleen, lymph nodes, and bone marrow; filters harmful substances from the blood and lymph

______ e. Located under the skin; provides padding, insulation, and a place to store fats

______ f. Located in the lymph nodes, spleen, tonsils, and thymus; forms certain types of white blood cells

______ g. Located along the walls of the large arteries and alveoli in the lungs; helps in maintaining blood pressure in the blood system and in the exhalation of breath in the lungs

______ h. Located throughout the blood system; transports materials, including oxygen, throughout the body and combats foreign organisms and cells

______ i. Located in loose accumulations between tissues and organs; connects tissues

______ j. Located in the nose, ears, trachea, and eustachian tubes and at bone joints; provides a firm-but-not-rigid structure and padding between bones .

OBJECTIVE 9 Define the basic types of nerve tissue. Write your answers on the blank lines provided beside each of the terms below.

a. Neurons ____

____

____

b. Neuroglia ____

____

____

OBJECTIVE 10 State the functions of the basic parts of a neuron. Write your answers on the blank lines provided beside each of the terms below.

a. Axon ____

____

b. Dendrite ____

____

c. Cell body ____

____

OBJECTIVE 11 Complete statements that describe how neurons function in the nervous system. Write your answers on the blank lines provided in the statements below.

a. Neurons are surrounded by specialized cells that form the ______________________, which electrically isolates neurons.

b. The ______________ of one neuron is separated from a ______________ of an adjoining neuron by a space called a *synapse.*

c. Nerve-system impulses cannot cross the synapse unless it is filled with special chemicals called ______________.

d. There are three kinds of neurons as determined by their location and function: ______________, ______________, and ______________.

e. ______________ neurons, which are sometimes referred to as *afferent neurons,* carry signals from receptors in the skin, skeletal muscles, joints, and organs to the central nervous system.

f. ______________ neurons, which are sometimes referred to as *efferent neurons,* carry impulses from the central nervous system to effectors that cause responses in the muscles and glands.

g. ______________, which are located in the central nervous system, carry either sensory or motor impulses or connect motor and sensory neurons and support higher-order functions such as thinking and learning.

Module 4: Tissues, Membranes, and Wound Healing

OBJECTIVE 12

State the functions of the types of neuroglia. Write your answers on the blank lines provided beside each of the terms below.

a. Oligodendrocytes ______________________________

b. Microglia ______________________________

c. Astrocytes ______________________________

d. Ependyma ______________________________

OBJECTIVE 13

Describe the factors that determine muscle-tissue classifications. Write your answers on the blank lines provided beside each of the terms below.

a. Structural composition ______________________________

b. Level of conscious control ______________________________

c. Location ______________________________

OBJECTIVE 14 Match types of muscle contractions to their correct definitions. Write the numbers on the blanks provided.

______ a. A movement that increases the angle of a joint

______ b. A toe-down movement of the foot at the ankle

______ c. A rotating movement of the forearm and hand so that the palm faces forward or upward; a corresponding movement of the foot and leg

______ d. A rotating movement on an axis

______ e. A movement of a limb toward the midline of the body

______ f. A movement of a part of the body toward the back

______ g. A rotating movement of the hand so that the palm faces backwards or downward; an inward and downward rotating motion of the foot

______ h. A movement of a limb away from the midline of the body

______ i. A movement that decreases the angle of a joint

1. Abduction
2. Adduction
3. Dorsiflexion
4. Extension
5. Flexion
6. Plantar flexion
7. Pronation
8. Rotation
9. Supination

OBJECTIVE 15 Define the term *neuromuscular excitability*. Write your answer on the blank lines provided beside the term below.

Neuromuscular excitability ____

____

____

____

OBJECTIVE 16 Complete statements that describe the neuromuscular-excitability response (sliding-filament theory). Write your answers on the blank lines provided in the statements below and on the next page.

a. Each muscle fiber is connected to the ______________________ of a motor nerve.

b. The point where the neuron terminates on a muscle fiber is referred to as the ___________________________ *junction*.

c. Sacs in the end of the nerve contain a neurotransmitter called ________________ (ACh).

d. The ______________________________ membrane of the muscle fiber has receptors that are sensitive to ACh.

e. During a normally relaxed state, the outer membrane of a muscle fiber is positively charged due to an abundance of positive __________________ ions and the core of the fiber is negatively charged due to an abundance of negative __________________ ions.

f. A nerve impulse arriving at the ______________________ causes a release of ACh.

g. ACh binds to the receptors in the fiber membrane, causing it to become permeable to __________________ and allowing the __________________ ions to move toward the core of the fiber.

h. An arrangement of filaments with the muscle fiber—called a __________________—shorten to contract the fiber.

i. Because virtually all of the fibers in the muscle are undergoing the same ______________________________, the entire muscle contracts.

j. As long as the impulses continue, the muscle will remain contracted in a condition known as __________________.

k. When the nerve impulses cease, the sarcolemma releases __________________, which inactivates the ACh.

l. The __________________ ions flow back to the surface of the fiber so that it returns to its normal charge state of a positively charged membrane and a negatively charged core.

OBJECTIVE 17 State the locations of the main types of membranes. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Mucous membrane ____

____

b. Serous membrane ____

____

c. Synovial membrane ______

d. Cutaneous membrane ______

OBJECTIVE 18 State the functions of the main types of membranes. Write your answers on the blank lines provided beside each of the terms below.

a. Mucous membrane ______

b. Serous membrane ______

c. Synovial membrane ______

d. Cutaneous membrane ______

OBJECTIVE 19 Define the term *organ*. Write your answer on the blank lines provided beside the term below.

Organ ______

OBJECTIVE 20 List the types of tissues and membranes found in selected organs. Write your answers on the blank lines provided beside the terms below.

a. Heart ______
b. Stomach ______
c. Nerves ______
d. Brain ______
e. Lungs ______

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OBJECTIVE 21

Complete statements that describe how organ systems function. Write your answers on the blank lines provided in the statements below.

a. Organs are collections of __________________ that are organized in such a way that they are able to perform specific functions.

b. The overall goal of these functions is to maintain a state of __________________ in the body.

c. Each organ system monitors one or more conditions __________________ to the body or in the body's __________________ environment.

d. The organs have feedback mechanisms that send signals to the ____________________________________ (CNS) about the conditions that they monitor.

e. The CNS provides response signals to organs in order to actuate regulation mechanisms designed to return the body to __________________.

f. Many of the response mechanisms involve __________________ or __________________ reactions.

g. Organs are also involved in the __________________ of materials throughout the body.

OBJECTIVE 22

Match terms describing abnormalities in organ development to their correct definitions. Write the numbers on the blanks provided.

1. Anaplasia
2. Aplasia
3. Atrophy
4. Dysplasia
5. Hyperplasia
6. Hypertrophy
7. Hypoplasia

_______ a. An increase in the size of an organ caused by an increase in the size of the cells rather than the number of cells

_______ b. An incomplete development or underdevelopment of an organ or tissue, which is usually the result of a decrease in the number of cells

_______ c. A developmental failure resulting in the absence of an organ or tissue

_______ d. An increase in the number of cells of a body part

_______ e. A change in the structure or orientation of cells characterized by the production of abnormal, undifferentiated cells

_______ f. Any abnormal development of tissues or organs

_______ g. A wasting or diminution of size or activity of a part of the body, usually the result of an abnormal decrease in cell size

OBJECTIVE 23 Define the types of injuries that can damage tissue. Write your answers on the blank lines provided beside each of the terms below.

a. Surgical incision ____

____

b. Traumatic wound ____

____

c. Chemical reaction ____

____

d. Frostbite ____

____

e. Bacterial infection ____

____

f. Burn ____

____

OBJECTIVE 24 Match the types of traumatic wounds to their correct definitions. Write the numbers on the blanks provided.

________ a. A wound caused by a force that does not break the skin but is sufficient to cause damage to subdermal tissues

________ b. A wound with little surface area that has been made by a sharp, slender object

________ c. A wound with irregular edges

________ d. A wound in which skin and underlying tissue are partially or completely torn away

________ e. A wound caused by an object passing completely through the body or a portion of the body

________ f. A wound caused by friction between the tissue and a mechanical force

________ g. A wound that is caused by pressure that is sufficient to alter or destroy tissue structure

________ h. A wound with smooth edges caused by a sharp surface

1. Abrasion
2. Avulsion
3. Contusion
4. Crush wound
5. Incised wound
6. Lacerated wound
7. Perforated wound
8. Puncture wound

OBJECTIVE 25

Describe the causes of the characteristics of the inflammation response. Write your answers on the blank lines provided beside each of the terms below.

a. Rubor ____

____

____

____

b. Heat ____

____

____

____

c. Swelling ____

____

____

____

d. Pain ____

____

____

____

OBJECTIVE 26

Complete statements that describe the phases in the body's healing response. Write your answers on the blank lines provided in the statements below and on the next page.

Lag phase (substrate phase)

a. Exudate containing ________________, ________________, and ________________ begins clotting and loosely binds the cut edges together.

b. Fibrin, clotting blood, and serum protein dry out, forming a ________________ to seal the wound.

c. ________________ remove bacteria and damaged tissue debris.

Healing phase (proliferative phase)

d. Fibroblasts multiply rapidly to bridge the wound gap, secreting fiber-forming ____________________.

e. Tensile strength grows rapidly as the ____________________ network of fibers builds.

f. New ____________________ form to replace ____________________ that were damaged by the injury.

Maturation phase (remodeling phase)

g. ____________________ tissue forms.

h. The ____________________ reforms into cross-links that further increase tensile strength.

i. As ____________________ density increases, the ____________________ makeup of the site decreases, reducing blood flow in the area so that the color of the site becomes closer to normal.

OBJECTIVE 27 Distinguish among statements that describe the types of treatment responses in the treatment of wounds. Write the numbers on the blanks provided below and on the next page. Numbers will be used more than once.

1. First-intention treatment
2. Second-intention treatment
3. Third-intention treatment

________ a. The wound is closed with a suture soon after the incision or trauma.

________ b. The wound is closed with a suture, but it is not closed immediately after the incision or trauma.

________ c. The wound is not closed with a suture.

________ d. There is excessive loss of tissue or poorly approximated tissue.

________ e. There may be loss of tissue due to infections or complications of the healing process.

________ f. There is no postoperative swelling.

________ g. There is serous discharge and infection, often after an initial suturing.

________ h. There is no serous discharge or infection.

________ i. There is serous discharge and infection.

________ j. There is minimal separation of the wound edges.

_______ k. There is excessive separation of the wound edges.

_______ l. There is excessive separation of the wound edges due to disruption of the healing process.

_______ m. There is significant scar formation.

_______ n. There is usually a deeper and wider scar formation.

_______ o. There is minimal scar formation.

_______ p. Healing may produce a weak union with some granulation forming in the infection site or area of poor healing.

_______ q. Healing is by primary union.

_______ r. Healing may produce a weak union with granulation tissue forming in the bottom of the wound and slowly contracting the wound together as it builds up.

_______ s. Healing is relatively fast.

_______ t. Healing takes longer than normal.

OBJECTIVE 28 Describe the factors that affect the wound-healing process. Write your answers on the blank lines provided beside each of the terms below and on the next page.

a. Age ____

____

____

b. Nutritional status ____

____

____

c. Electrolyte balance ____

____

____

d. Physical condition ____

____

____

e. Surgical technique ______

f. Infection ______

g. Therapy ______

h. Complications ______

i. Exercise ______

OBJECTIVE 29 Define factors that present possible complications to the wound-healing process. Write your answers on the blank lines provided beside each of the terms below.

a. Hemorrhage ______

b. Sinus-tract formation ______

c. Hematoma ______

d. Infection ______

e. Herniation ______

f. Wound disruption ______

OBJECTIVE 30

Match the classifications of surgical wounds to their correct descriptions. Write the numbers on the blanks provided. Answers will be used more than once.

1. Clean
2. Clean/contaminated
3. Contaminated
4. Infected

_______ a. Has an expected infection rate of 27 to 40 percent

_______ b. Has an expected infection rate of 15 to 20 percent

_______ c. Has an expected infection rate of 8 to 11 percent

_______ d. Has an expected infection rate of 1 to 5 percent

_______ e. Involves an internal procedure done under less-than-ideal conditions

_______ f. Involves an internal procedure done under near-ideal conditions

_______ g. Involves an elective procedure done under ideal conditions

_______ h. Exhibits primary closure with no drainage

_______ i. Started as an open, fresh, traumatic wound less than four hours old

_______ j. Exhibits normal drainage during procedure

_______ k. Was subjected to major breaks in aseptic technique

_______ l. Was subjected to microbial contamination in the operative field before the procedure

_______ m. Was subjected to minor breaks in aseptic technique

_______ n. Was not subjected to breaks in aseptic technique

_______ o. Shows acute bacterial inflammation that may be purulent or be a known clinical infection

_______ p. Shows no inflammation

_______ q. Shows acute, nonpurulent inflammation

_______ r. Did not require entry into alimentary, genitourinary, or respiratory tracts or oropharyngeal cavity

_______ s. Involved exposure to a perforated organ, such as a bowel

_______ t. Required entry that resulted in gross spillage or contamination from the gastrointestinal tract, entry into the biliary tract with infected bile present, entry into the genitourinary tract with urine present, or similar contamination

_______ u. Required entry into alimentary, genitourinary, or respiratory tract or orophayngeal cavity under controlled conditions

Answers to Written Test

OBJECTIVE 1

A collection of cells that share a similar structure and are organized to perform a specific function

OBJECTIVE 2

a. 3
b. 4
c. 2
d. 1

OBJECTIVE 3

a. Provides a protective barrier against extreme temperatures, environmental contaminants, and invasions by microorganisms while allowing secretion and excretion of wastes

b. Binds to other tissue structures to support and organize the body; binds to foreign cells to protect the body; binds to molecules to transport materials through the body

c. Allows the movement of the movable structures of the body

d. Conducts electrical signals through the body

OBJECTIVE 4

a. body; parts
b. serous; blood; lymph; respiratory; digestive; urinary
c. glands
d. intercellular
e. basement membrane
f. capillaries
g. mitosis

OBJECTIVE 5

a. Tissue consisting of flat cells that somewhat resemble scales

b. Tissue consisting of cells that somewhat resemble square boxes, having dimensions approximately the same height, width, and depth

c. Tissue consisting of cells that somewhat resemble rectangular boxes, having one dimension that is longer than the others

OBJECTIVE 6

a. Tissue consisting of a single layer of cells
b. Tissue consisting of more than one layer of cells

OBJECTIVE 7

a. 2
b. 5
c. 1
d. 4
e. 3

Objective 8

a. 4
b. 7
c. 9
d. 10
e. 1
f. 8
g. 6
h. 3
i. 2
j. 5

Objective 9

a. The basic nerve-tissue cells of the nervous system that are capable of generating electrochemical impulses that carry information to and from the brain

b. The supporting- or connecting-tissue cells of the central nervous system

Objective 10

a. Carries nervous-system impulses from the cell body

b. Carries nervous-system impulses to the cell body

c. Performs metabolic and reproductive functions for the cell

Objective 11

a. Sheat of Schwann
b. axon; dendrite
c. neurotransmitters
d. sensory; motor; interneurons
e. Sensory
f. Motor
g. Interneurons

Objective 12

a. Form the insulating sheath on neurons in the central nervous system

b. Move so that they can locate and destroy damaged tissue and invading cells and organisms

c. Prevent harmful chemicals from entering the brain from contaminated blood

d. Line the cavities in the brain and help to circulate cerebrospinal fluid

Objective 13

a. Whether the muscle tissue is striated or smooth (nonstriated)

b. Whether the muscle is voluntary or involuntary

c. Whether the muscle tissue is skeletal, visceral, or cardiac

Objective 14

a. 4
b. 6
c. 9
d. 8
e. 2
f. 3
g. 7
h. 1
i. 5

Objective 15

The response of muscle tissue to stimulation by the nervous system

OBJECTIVE 16

a. motor axon
b. neuromuscular
c. acetylcholine
d. sarcolemma
e. sodium; potassium
f. motor axon
g. sodium; sodium
h. sarcomere
i. neuromuscular excitation
j. tetanus
k. cholinesterase
l. sodium

OBJECTIVE 17

a. Lines cavities and passages that open to the exterior

b. Lines the closed cavities of the body

c. Lines the skeletal joints, tendons, and bursae

d. Covers the body as skin

OBJECTIVE 18

a. Forms a selective filter that allows some substances to enter the body while keeping others out; secretes mucus to keep its cells moist, to lubricate its surfaces, and to trap foreign particles

b. Provides the visceral layer that covers organs enclosed in cavities; provides the parietal layer that lines cavities; secretes serous fluid to serve as a lubricant and pad between visceral and parietal layers

c. Secretes synovial fluid to provide lubrication and moisture

d. Secretes sweat and wastes to help maintain homeostasis

OBJECTIVE 19

A structure consisting of two or more tissues that performs a specific function for the body

OBJECTIVE 20

a. Simple squamous epithelial tissue, fibrous connective tissue, cardiac muscle tissue, serous membrane

b. Fibrous connective tissue, smooth muscle tissue, mucous membrane, serous membrane

c. Nerve tissue

d. Nerve tissue

e. Elastic connective tissue, epithelial tissue

Module 4: Tissues, Membranes, and Wound Healing

OBJECTIVE 21

a. tissues
b. homeostasis
c. internal; external
d. central nervous system
e. homeostasis
f. physical; chemical
g. transport

OBJECTIVE 22

a. 6
b. 7
c. 2
d. 5
e. 1
f. 4
g. 3

OBJECTIVE 23

a. The separation of intact tissue by a surgeon using aseptic techniques

b. An injury to living body tissue caused by an extrinsic agent

c. An injury to body tissue that is the result of a response of the body to exposure to a chemical

d. Local damage to tissue as a result of exposure to low temperatures

e. The death of cells as a result of the action of microorganisms

f. Damage to tissue due to exposure to a high-energy source

OBJECTIVE 24

a. 3
b. 8
c. 6
d. 2
e. 7
f. 1
g. 4
h. 5

OBJECTIVE 25

a. Immediately upon the occurrence of an insult to a site, the blood vessels in that area constrict and then dilate, allowing blood to pool in the area as the vessels fill and blood is unable to flow quickly through the undilated vessels beyond the injured area.

b. White blood cells begin to accumulate in the injury site, attaching to the blood-vessel walls and leading the body to release stored white blood cells. The white blood cells begin to pass through the walls of the blood vessels to fill the interstitial spaces, attracted by chemicals such as kinins released by the injured tissues. The purpose of the white blood cells is to attack pathogens that may have entered the wound. They also fill the area with concentrated warmth.

c. As white blood cells, chemicals, fluids that leak from damaged blood vessels and cells, and other inflammatory exudate the interstitial areas, the injury site begins to bulge. Certain proteins in the interstitial solution transform into fibrin to form clots that seal the area. This helps to isolate the site so that pathogens are contained and infection is more easily prevented. This accumulation of body fluid is referred to as *edema*.

d. The inflammatory exudate, especially the chemicals released by the injured cells, result in pain. The pain may help to protect the site by telling the organism to give it attention and to be careful with it.

OBJECTIVE 26

a. blood; lymph; fibrinogen
b. scab
c. Leukocytes
d. collagen
e. collagen
f. cells; cells
g. Scar
h. collagen
i. collagen; vascular

OBJECTIVE 27

a. 1
b. 3
c. 2
d. 2
e. 3
f. 1
g. 3
h. 1
i. 2
j. 1
k. 2
l. 3
m. 2
n. 3
o. 1
p. 3
q. 1
r. 2
s. 1
t. 2, 3

OBJECTIVE 28

a. The body's ability to heal declines as a person ages.

b. The production of cells and tissues as part of the healing process requires an adequate supply of the proper nutrients.

c. The transport to the wound site of nutrients, oxygen, hormones, and other substances that promote healing depends on the pathways provided by blood and interstitial fluids.

d. The good circulation and lack of fat associated with good physical conditioning reduce the chances of a wound becoming infected.

e. Good surgical technique complements the body's healing functions while poor surgical technique interferes with the healing process.

f. The fighting of an infection reduces the amount of nutrients, oxygen, and other substances that can be involved in the healing process; further, the pathogens may produce toxins that interfere with the body's chemicals that are involved in healing.

g. Treatment provided to the patient through therapy may include medications or procedures that either slow or improve the healing process.

h. Outside influences not directly related to the surgery can interfere with wound healing.

i. The improved circulation that comes with exercise helps to deliver oxygen, nutrients, and other resources required for healing to the wound.

Objective 29

a. The loss of a large amount of blood in a short time caused by a failure of open blood vessels to adequately clot or to remain sealed

b. The development of channels that permit the escape of purulent materials from pockets of pus and other fluids

c. A swelling or tumor that contains blood that is generally clotted

d. The presence of pathogens in a wound site

e. A protrusion of an organ or tissue structure into a wound site

f. One of the conditions—dehiscence, evisceration, or eventration—that interrupts the wound-healing process

Objective 30

a. 4
b. 3
c. 2
d. 1
e. 3, 4
f. 2
g. 1
h. 1, 4
i. 3
j. 2
k. 3
l. 4
m. 2
n. 1
o. 4
p. 1, 2
q. 3
r. 1
s. 4
t. 3
u. 2

Answers to Assignment Sheet

Assignment Sheet 1

CASE STUDY 1

Suggested answers

a. Epithelial tissues contain and route body fluids, absorb nutrients, and secrete hormones that regulate body functioning. These actions ensure that cells are sustained and provided with the chemicals needed to carry out metabolic actions.

b. Connective tissues transport nutrients and disease-fighting components (blood), support and protect organs (bone/cartilage), and provide padding and insulation (adipose). Thus, blood helps to sustain cell metablism and spread energy (heat) through the body, bones and cartilage produce blood and protect organs that contribute to homeostasis, and adipose tissue helps reduce the loss of body heat.

c. Muscle tissues permit the body to move, which is necessary to find food and shelter and to protect the body from environmental factors that would interfere with homeostasis, such as extreme heat or cold, exposure to rain or severe winds, etc.

d. Nerve tissues monitor internal conditions to control metabolic functions, gland secretions, and other activities to maintain homeostasis. They monitor external conditions and initiate body responses such as shivering, fright, reflexes, etc., in response to those conditions.

CASE STUDY 2

Suggested answers

Body fat permits the storage of reserve energy that can be made available to the body when the demand for energy exceeds the intake of calories, such as when food is not available, digestion is restricted, the body is exposed to cold, during periods of exercise, or during the healing process. If body fat is too low, this reserve is not available. However, excessive body fat is associated with health-threatening conditions such as high blood pressure, cardiovascular disease, and stress on organ functions. A surgical patient with low body fat may not have adequate energy reserves to sustain the healing process, especially if the surgery or medications reduce nutrient intake or absorption or affect cell metabolism or appetite. Excessive body fat can complicate surgical procedures by reducing access to operative sites and increasing the risk of heart failure or other complications. Fatty tissue does not provide a good suture field and can interfere with proper wound healing.

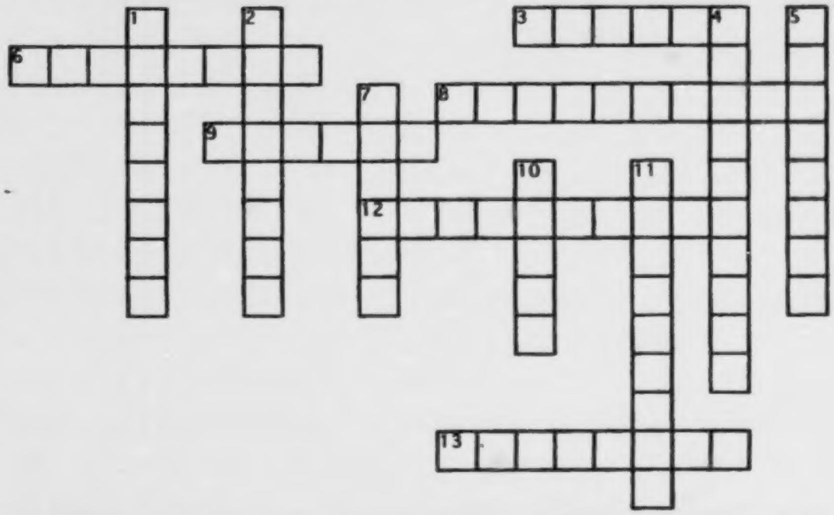
CASE STUDY 3

Answers to this case study will depend on the type of cancer the student is assigned. Student responses must be evaluated to the satisfaction of the instructor.

Module Set I: Introduction to Anatomy and Physiology
Module 4: Tissues, Membranes, and Wound Healing

Crossword Puzzle 1—Terms from Objectives 1 Through 5

Name ______________________________ Date ______________



ACROSS

3. A collection of cells that share a similar structure and are organized to perform a specific function
6. Tissue consisting of cells that somewhat resemble square boxes, having dimensions approximately the same height, width, and depth
8. The covering of the internal organs of the body, also the lining of the vessels, body cavities, glands, and organs
9. Epithelial tissue that lines closed body cavities and covers the organs in that cavity
12. Dense tissue containing large numbers of cells and large amounts of intercellular material composed of fibers in a matrix or ground substance that may be liquid, gelatinous, or solid
13. Tissue consisting of flat cells that somewhat resemble scales

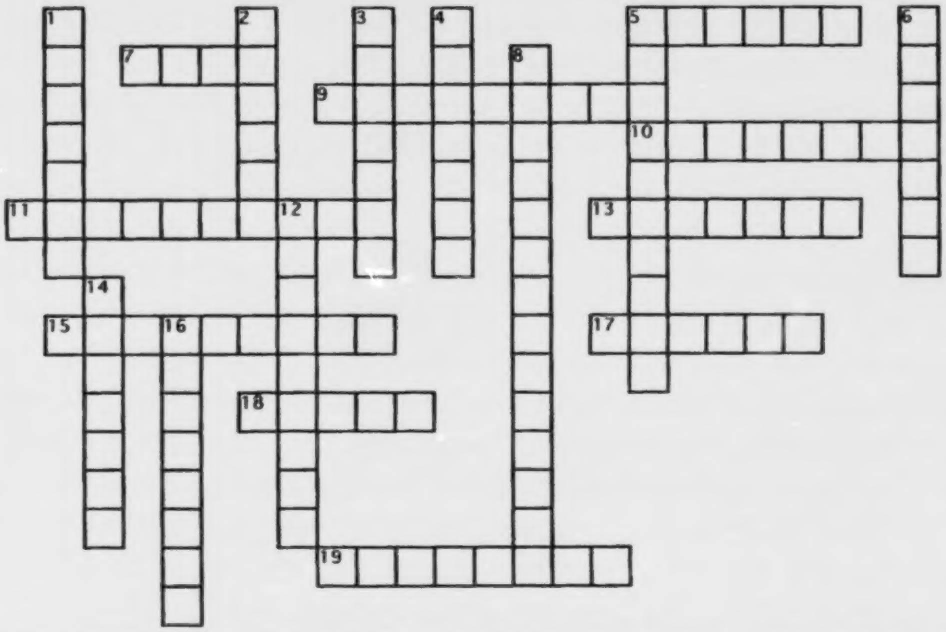
DOWN

1. Tissue consisting of cells that somewhat resemble rectangular boxes, having one dimension that is longer than the others
2. The fragile, noncellular layer of tissue that secures the overlying layers of stratified epithelium is called the ______ *membrane*
4. Tissue consisting of cells bound by connective material and varying in the number of layers and in the kinds of cells
5. A thin layer of tissue that covers a surface, lines a cavity, or divides a space
7. Tissue composed of fibers that are able to contract, causing and allowing movement of the parts and organs of the body
10. Tissue consisting of one or more bundles of impulse-carrying fibers that connect the brain and the spinal cord with other parts of the body
11. The process of a substance moving from an area of high concentration to an area of lower concentration

Module Set I: Introduction to Anatomy and Physiology
Module 4: Tissues, Membranes, and Wound Healing

Crossword Puzzle 2—Terms from Objectives 6 Through 8

Name ______________________________ Date ______________



ACROSS

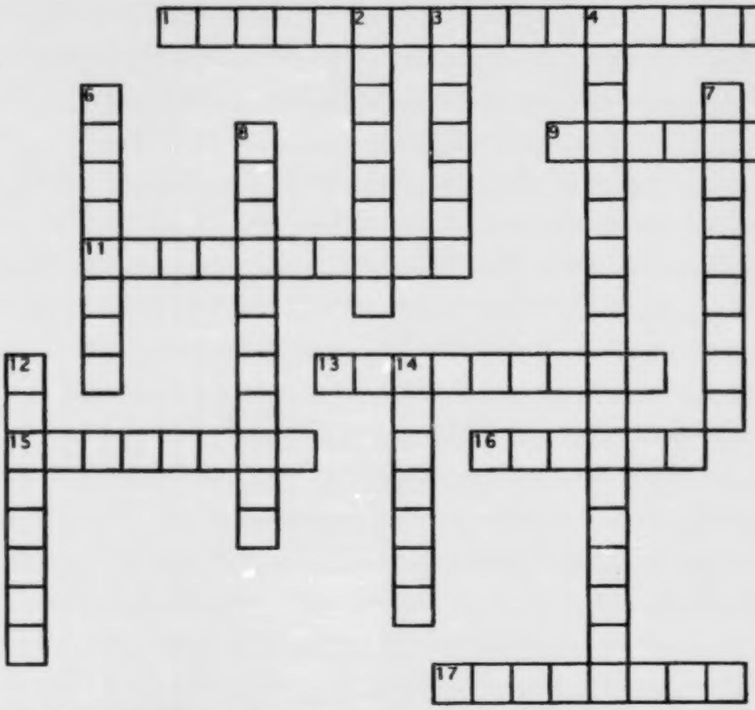
5. Tissue consisting of a single layer of cells
7. Tissue located in the skeleton; forms bones to support the body and protect organs and tissues
9. Tissue located in the spleen, lymph nodes, and bone marrow; filters harmful substances from the blood and lymph
10. One of many small sacs within the lungs in which the exchange of gases take place, absorbing oxygen and releasing carbon dioxide
11. A band of connective tissue that covers or binds together body structures within body cavities (2 words)
13. Tissue located in tendons, ligaments, deep fascia, dermis, and the kidneys; provides strong, flexible connections and the formation of scars
15. Tissue located in the lymph nodes, spleen, tonsils, and thymus; forms certain types of white blood cells
17. A fibrous connective tissue that connects muscle to bones
18. Tissue located throughout the blood system; transports materials, including oxygen, throughout the body and combats foreign organisms and cells
19. A fibrous connective tissue that joins one bone to another

DOWN

1. The windpipe
2. The connective tissue that makes up the inner layer of skin
3. Tissue located in loose accumulations between tissues and organs; connects tissues
4. Tissue located under the skin; provides padding, insulation, and a place to store fats
5. Tissue consisting of more than one layer of cells
6. Tissue located along the walls of the large arteries and alveoli in the lungs; helps in maintaining blood pressure in the blood system and in the exhalation of breath in the lungs
8. A canal that allows air to pass between the middle-ear cavity and the nasopharyngeal cavity (2 words)
12. Tissue located in the nose, ears, trachea, and eustachian tubes and at bone joints; provides a firm-but-not-rigid structure and padding between bones
14. Tissue located in the bone marrow; forms red and white blood cells and platelets
16. A blood cell that helps the clotting process used to seal a wound

Crossword Puzzle 3—Terms from Objectives 9 Through 13

Name ______________________________ **Date** ______________



ACROSS

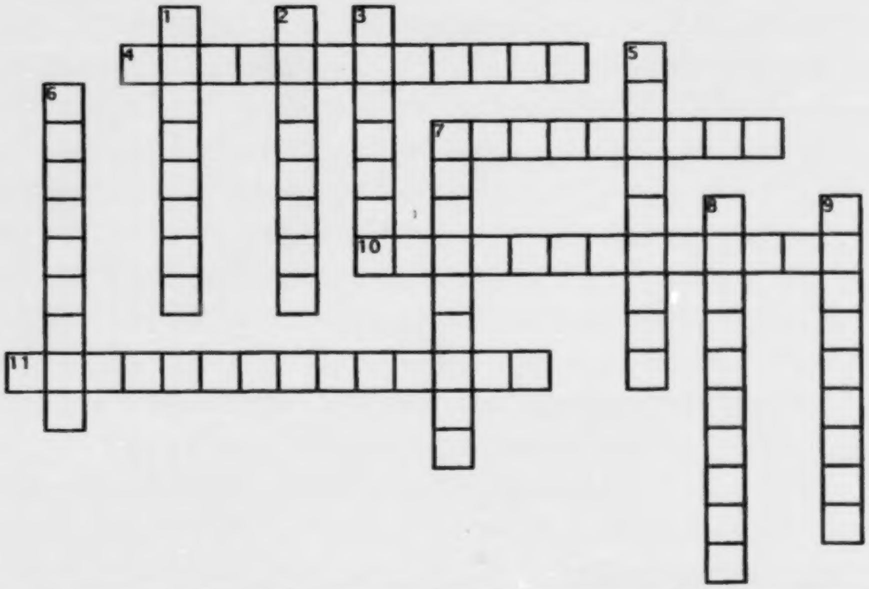
1. Neuroglia that form the insulating sheath on neurons in the central nervous system
9. The supporting- or connecting-tissue cells of the central nervous system
11. Neuroglia that prevent harmful chemicals from entering the brain from contaminated blood
13. Neuroglia that move so that they can locate and destroy damaged tissue and invading cells and organisms
15. Striated, voluntary muscle tissue attached to bones
16. A covering, especially a loose-fitting one
17. Neuroglia that line the cavities in the brain and help to circulate cerebrospinal fluid

DOWN

2. The part of a neuron that carries nervous-system impulses to the cell body
3. The basic nerve-tissue cells of the nervous system that are capable of generating electrochemical impulses that carry information to and from the brain
4. The tissue fluid that circulates around the brain and spinal cord (2 words)
5. The part of a neuron that performs metabolic and reproductive functions for the cell (2 words)
6. Lined with grooves
7. Muscles that are consciously controlled by the will of a person
8. Muscles that work automatically
10. The part of a neuron that carries nervous-system impulses from the cell body
12. Smooth, involuntary muscle tissue that lines the walls of hollow organs
14. Striated, involuntary muscle tissue that composes the walls of the heart

Crossword Puzzle 4—Terms from Objectives 14 Through 16

Name ______________________________ Date ______________



ACROSS

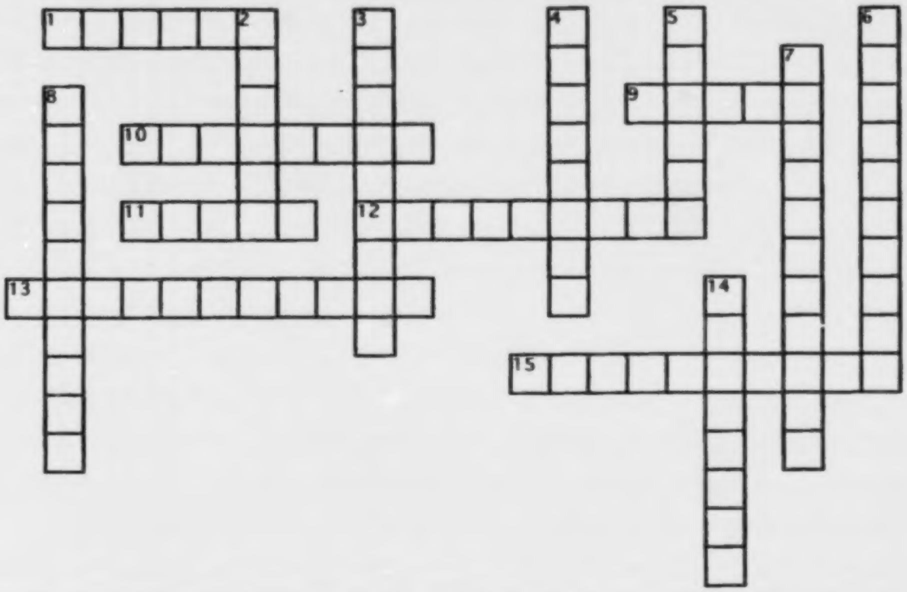
4. A movement of a part of the body toward the back
7. A movment of a limb toward the midline of the body
10. The response of muscle tissue to stimulation by the nervous system is called ______ *excitability*
11. A toe-down movement of the foot at the ankle (2 words)

DOWN

1. A rotating movement on an axis
2. A threadlike, flexible structure
3. A movement that decreases the angle of a joint
5. A movement that increases the angle of a joint
6. Capable of allowing substances to penetrate a structure
7. A movement of a limb away from the midline of the body
8. A rotating movement of the forearm and hand so that the palm faces forward or upward; a corresponding movement of the foot and leg
9. A rotating movement of the hand so that the palm faces backwards or downward; an inward and downward rotating motion of the foot

Crossword Puzzle 5—Terms from Objectives 17 Through 20

Name ______________________________ Date ______________



ACROSS

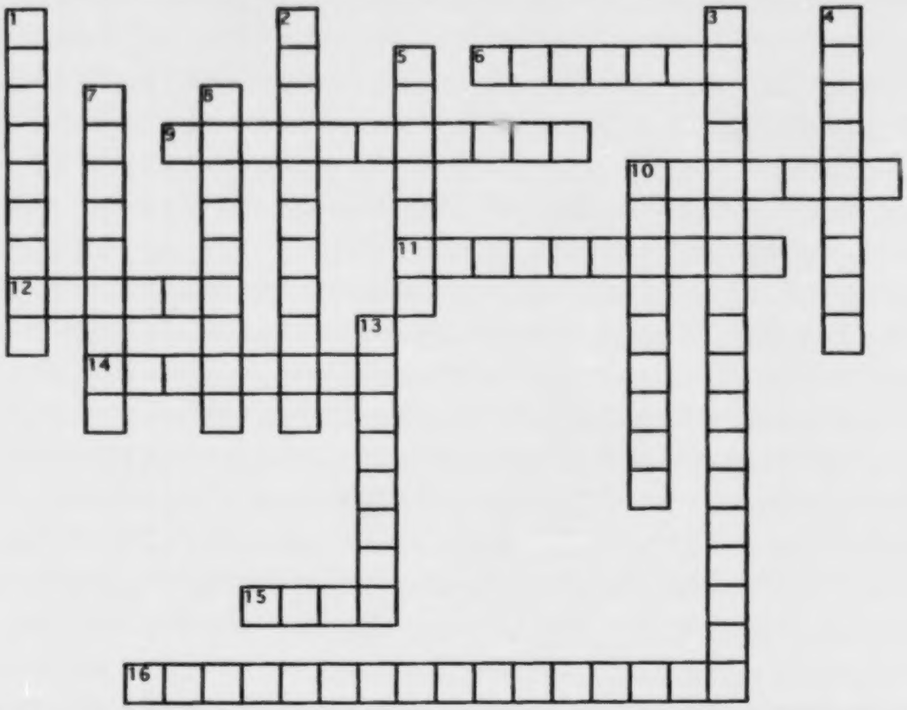
1. Membrane that lines cavities and passages that open to the exterior
9. A structure consisting of two or more tissues that performs a specific function for the body
10. Membrane that lines the skeletal joints, tendons, and bursae
11. A sac of synovial fluid that helps to reduce friction between a bone and tendon
12. The outer layer of skin made up of an outer, dead portion and a deeper, living, cellular portion
13. A sac that surrounds the heart
15. The thick middle layer of the heart wall

DOWN

2. Membrane that lines the closed cavities of the body
3. Membrane that covers the body as skin
4. Of or pertaining to the viscera, or internal organs in the abdominal cavity
5. The inner layer of skin consisting of papillary and reticular layers and containing blood and lymphatic vessels, nerves and nerve endings, glands, and hair follicles
6. An extensive serous membrane that covers the entire abdominal wall of the body
7. The lining of the heart chambers
8. The layer of areolar tissue and fat that lies beneath the dermis
14. Of or pertaining to the outer wall of a cavity or organ

Crossword Puzzle 6—Terms from Objectives 21 Through 23

Name ______________________________ Date ______________



ACROSS

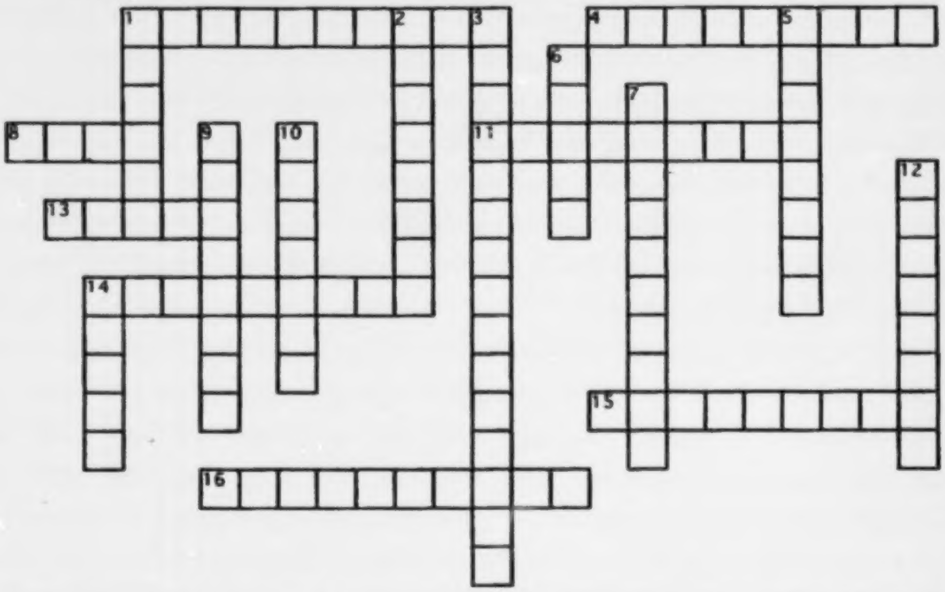
6. A developmental failure resulting in the absence of an organ or tissue
9. An increase in the size of an organ caused by an increase in the size of the cells rather than the number of cells
10. Free from pathogens
11. An incomplete development or underdevelopment of an organ or tissue, which is usually the result of a decrease in the number of cells
12. An injury to living tissue caused by an extrinsic agent
14. A surgical ______ is the separation of intact tissue by a surgeon using aseptic techniques
15. Damage to tissue due to exposure to a high-energy source
16. An injury to body tissue that is the result of a response of the body to exposure to a chemical (2 words)

DOWN

1. Local damage to tissue as a result of exposure to low temperatures
2. An increase in the number of cells of a body part
3. The death of cells as a result of the action of microorganisms (2 words)
4. Outside of and not part of (the body)
5. A wasting or diminution of size or activity of a part of the body, usually the result of an abnormal decrease in cell size
7. A ______ wound is an injury to living body tissue caused by an extrinsic agent
8. Any abnormal development of tissues or organs
10. A change in the structure or orientation of cells characterized by the production of abnormal, undifferentiated cells
13. A smooth-sided wound, especially one made during surgery

Crossword Puzzle 7—Terms from Objectives 24 Through 26

Name ______________________________ Date ______________



ACROSS

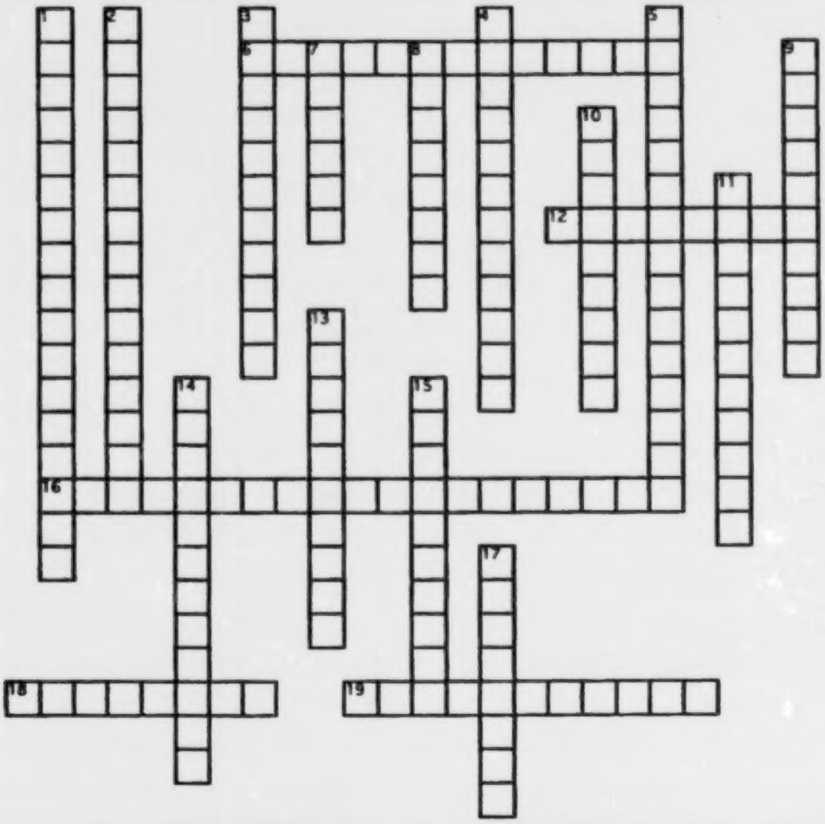
1. A connective tissue cell that produces collagen and elastin fibers
4. A wound with irregular edges
8. A mark left on the skin as a result of an injury
11. Below the skin
13. A polypeptide hormone that forms in the tissues and has its chief effect on smooth muscle
14. A wound caused by a force that does not break the skin but is sufficient to cause damage to subdermal tissues
15. Another term for a white blood cell
16. A protein produced by the liver that is converted into fibrin by thrombin to promote clotting at an injury site

DOWN

1. A stringy, insoluble protein produced in the clotting process
2. A wound caused by friction between the tissue and a mechanical force
3. A material's resistance to being torn apart by opposing forces (2 words)
5. A wound in which skin and underlying tissue are partially or completely torn away
6. The medical term for redness
7. A wound caused by an object passing completely through the body or a portion of the body
9. A wound with little surface area that has been made by a sharp, slender object
10. A wound with smooth edges caused by a sharp surface
12. A protein that composes strong fibers in several types of connective tissue
14. A wound that is caused by pressure that is sufficient to alter or destroy tissue structure

Crossword Puzzle 8—Terms from Objectives 27 Through 30

Name ______________________________ Date ______________



ACROSS

6. A term meaning "following a surgical procedure"
12. A swelling or tumor that contains blood that is generally clotted
16. The development of channels that permit the escape of purulent materials from pockets of pus and other fluids (3 words)
18. The ability to carry out life functions efficiently
19. The partial protrusion of the abdominal contents through an opening in the abdominal wall

DOWN

1. Any soft, pink, fleshy projections that form during the healing process in a wound not healing by first intention (2 words)
2. One of the conditions—dehiscence, evisceration, or eventration—that interrupts the wound-healing process (2 words)
3. To bring two tissue surfaces close together, as in the repair of a wound
4. The situation in which severed tissue is essentially reunited with the tissue from which it was originally separated and that the healing process begins without disruptions from swelling, contamination, infection, and other factors (2 words)
5. An organ punctured in such a way that the contents of the organ could exude onto other structures (2 words)
7. A stitch placed in tissue to hold the sides of a wound together during the healing process
8. Containing pus
9. A protrusion of an organ or tissue structure into a wound site
10. The presence of pathogens in a wound site
11. Without pus
13. The separation of the layers of a surgical wound
14. The extrusion of internal organs or viscera through a dehiscence
15. The loss of a large amount of blood in a short time caused by a failure of open blood vessels to adequately clot or to remain sealed
17. An operation done by choice as opposed to being performed as an emergency is called an ______ *procedure*

Answers to Crossword Puzzles

Crossword Puzzle 1

ACROSS
3. TISSUE
6. CUBOIDAL
8. EPITHELIUM
9. SEROUS
12. CONNECTIVE
13. SQUAMOUS

DOWN
1. COLUMNAR
2. BASEMENT
4. EPITHELIAL
5. MEMBRANE
7. MUSCLE
10. NERVE
11. DIFFUSION

Crossword Puzzle 2

ACROSS
5. SIMPLE
7. BONE
9. RETICULAR
10. ALVEOLUS
11. DEEP FASCIA
13. FIBROUS
15. LYMPHATIC
17. TENDON
18. BLOOD
19. LIGAMENT

DOWN
1. TRACHEA
2. DERMIS
3. AREOLAR
4. ADIPOSE
5. STRATIFIED
6. ELASTIC
8. EUSTACHIAN TUBE
12. CARTILAGE
14. MYELOID
16. PLATELET

Crossword Puzzle 3

ACROSS
1. OLIGODENDROCYTES
9. NEUROGLIA
11. ASTROCYTES
13. MICROGLIA
15. SKELETAL
16. SHEATH
17. EPENDYMA

DOWN
2. DENDRITE
3. NEURONS
4. CEREBROSPINAL FLUID
5. CELL BODY
6. STRIATED
7. VOLUNTARY
8. INVOLUNTARY
10. AXON
12. VISCERAL
14. CARDIAC

Crossword Puzzle 4

ACROSS

4. DORSIFLEXION
7. ADDUCTION
10. NEUROMUSCULAR
11. PLANTAR FLEXION

DOWN

1. ROTATION
2. FILAMENT
3. FLEXION
5. EXTENSION
6. PERMEABLE
7. ABDUCTION
8. SUPINATION
9. PRONATION

Crossword Puzzle 5

ACROSS

1. MUCOUS
9. ORGAN
10. SYNOVIAL
11. BURSA
12. EPIDERMIS
13. PERICARDIUM
15. MYOCARDIUM

DOWN

2. SEROUS
3. CUTANEOUS
4. VISCERAL
5. DERMIS
6. PERITONEUM
7. ENDOCARDIUM
8. HYPODERMIS
14. PARIETAL

Crossword Puzzle 6

ACROSS

6. APLASIA
9. HYPERTROPHY
10. ASEPTIC
11. HYPOPLASIA
12. TRAUMA
14. INCISION
15. BURN
16. CHEMICAL REACTION

DOWN

1. FROSTBITE
2. HYPERPLASIA
3. BACTERIAL INFECTION
4. EXTRINSIC
5. ATROPHY
7. TRAUMATIC
8. DYSPLASIA
10. ANAPLASIA
13. INCISION

Crossword Puzzle 7

ACROSS

1. FIBROBLAST
4. LACERATED
8. SCAR
11. SUBDERMAL
13. KININ
14. CONTUSION
15. LEUKOCYTE
16. FIBRINOGEN

DOWN

1. FIBRIN
2. ABRASION
3. TENSILE STRENGTH
5. AVULSION
6. RUBOR
7. PERFORATED
9. PUNCTURE
10. INCISED
12. COLLAGEN
14. CRUSH

Crossword Puzzle 8

ACROSS

6. POSTOPERATIVE
12. HEMATOMA
16. SINUS TRACT FORMATION
18. VITALITY
19. EVENTRATION

DOWN

1. GRANULATION TISSUE
2. WOUND DISRUPTION
3. APPROXIMATE
4. PRIMARY UNION
5. PERFORATED ORGAN
7. SUTURE
8. PURULENT
9. HERNIATION
10. INFECTION
11. NONPURULENT
13. DEHISCENCE
14. EVISCERATION
15. HEMORRHAGE
17. ELECTIVE

Module Set I: Introduction to Anatomy and Physiology
Module 4: Tissues, Membranes, and Wound Healing

Module Review

Name ______________________________

Date ____________________ Score ____________________

DIRECTIONS Read each of the items below. From the choices given, select the response that most-correctly provides the required information. Circle the letter of the most-correct response.

Objective 7

1. ______ tissue lines glands such as the thyroid and salivary glands; the shape of the tissue promotes secretion of chemicals by the glands.

   a. Squamous

   b. Cuboidal

   c. Columnar

   d. Stratified

Objective 9

2. Neurons are capable of generating ______ impulses that carry information to and from the brain.

   a. mechanical

   b. chemical

   c. electromagnetic

   d. electrochemical

Objective 12

3. ______ prevent harmful chemicals from entering the brain from contaminated blood.

   a. Microglia

   b. Astrocytes

   c. Oligodendrocytes

   d. Ependyma

Objective 23

4. A traumatic wound is ______.

   a. the separation of intact tissue by a surgeon using aseptic techniques

   b. an injury to living body tissue caused by an extrinsic agent

   c. a response of the body due to exposure to a chemical

   d. the death of cells as a result of the action of microorganisms

Objective 22

5. Any abnormal development of tissues or organs is ______.

   a. hypoplasia
   b. atrophy
   c. hyperplasia
   d. dysplasia

Objective 8

6. Which of the following statements are NOT true?

   a. A tendon is a fibrous connective tissue that joins one bone to another.
   b. A ligament is a fibrous connective tissue that joins one bone to another.
   c. A tendon is a fibrous connective tissue that connects muscle to bones.
   d. A ligament is bone tissue that joins one bone to another.

Objective 2

7. Tissue consisting of cells bound together by connective material and varying in the number of layers and the kinds of cells is ______ tissue.

   a. connective
   b. muscle
   c. epithelial
   d. nerve

Objective 3

8. ______ tissue consists of impulse-carrying fibers that connect the brain and the spinal cord with other parts of the body.

   a. Epithelial
   b. Connective
   c. Nerve
   d. Muscle

Objective 8

9. ______ tissue is a type of connective tissue located in the lymph nodes, spleen, tonsils, and thymus, and it forms certain types of white blood cells.

   a. Lymphatic
   b. Cartilage
   c. Bone
   d. Blood

Objective 11

10. Neurons are surrounded by specialized cells that form the ______.

a. Sheath of Schwann, which electrically isolates neurons

b. Golgi apparati, which support the neurons

c. interstitial cells that improve the electrical conductivity of the neurons

d. none of the above

Objective 16

11. Each muscle fiber is connected to the motor ______ of a motor nerve.

a. axon

b. dendrite

c. synapse

d. nephron

Objective 16

12. When the nerve impulses to a muscle cease, the ______ releases cholinesterase, which inactivates the ACh.

a. sarcomere

b. sarcolemma

c. sodium-potassium junction

d. cholinesterase sac

Objective 21

13. ______ are collections of tissues that are organized in such a way that they are able to perform specific functions.

a. Organs

b. Membranes

c. Organisms

d. Carbohydrates

Objective 27

14. Which of the following statements is NOT true with regard to third-intention wound treatment?

a. The wound is not closed with a suture.

b. There may be loss of tissue due to infections or complications of the healing process.

c. There is excessive separation of the wound edges due to disruption of the healing process.

d. Healing takes longer than normal.

Objective 30

15. To qualify as a contaminated (Class III) wound, treatment must have started on an open, fresh, traumatic wound less than ______ hours old.

a. two

b. three

c. four

d. six

Objective 11

16. Sensory neurons are sometimes referred to as ______ *neurons.*

a. *efferent*

b. *afferent*

c. *effector*

d. *transmitter*

Objective 1

17. A ______ is a collection of cells that share a similar structure and are organized to perform a specific function.

a. serous cavity

b. nerve

c. neuron

d. tissue

Objective 3

18. ______ tissue allows the movement of the movable structures of the body.

a. Epithelial

b. Connective

c. Nerve

d. Muscle

Objective 8

19. ______ tissue is a type of connective tissue located under the skin, and it functions to provide padding, insulation, and a place to store fats.

a. Areolar

b. Adipose

c. Bone

d. Blood

Objective 12

20. ______ line the cavities in the brain and help to circulate cerebrospinal fluid.

   a. Microglia

   b. Astrocytes

   c. Oligodendrocytes

   d. Ependyma

Objective 4

21. Epithelial cells undergo constant ______ in order to replace the outer-layer cells that are lost through wear and exposure to forces and the environment..

   a. exfoliation

   b. growth

   c. meiosis

   d. mitosis

Objective 13

22. ______ tissue is striated, involuntary muscle tissue that composes the walls of the heart.

   a. Cardiac

   b. Skeletal

   c. Cartilage

   d. Visceral

Objective 14

23. A movement of the foot toward the back is ______.

   a. dorsiflexion

   b. pronation

   c. plantar flexion

   d. supination

Objective 16

24. Sacs in the end of the nerve contain a neurotransmitter called ______ (ACh).

   a. *acidic cholinesterase*

   b. *acidic chloride*

   c. *acetylchlorine*

   d. *acetylcholine*

Objective 19

25. A structure consisting of two or more tissues that performs a specific function for the body is ______.

a. an organ

b. a membrane

c. a viscera

d. an epi-connective junction

Objective 24

26. A wound with irregular edges is ______ wound.

a. a lacerated

b. a puncture

c. a perforated

d. an incised

Objective 28

27. Which of the following factors is most likely to improve the healing process?

a. advanced age

b. substantial body fat

c. nonstressful exercise

d. electrolyte imbalance

Objective 25

28. Which of the characeristics of the inflammation response can be described by the following statement? "White blood cells, chemicals, and fluids leak from damaged blood vessels and cells and certain proteins in the interstitial solution transform into fibrin to form clots that seal the area."

a. rubor

b. heat

c. swelling

d. pain

Objective 7

29. ______ tissue lines the stomach and intestines and secretes gastric juices and enzymes.

a. Columnar

b. Simple

c. Cuboidal

d. Stratified

Objective 2

30. Tissue consisting of one or more bundles of impulse-carrying fibers that connect the brain and the spinal cord with other parts of the body is ______ tissue.

a. connective

b. muscle

c. epithelial

d. nerve

Objective 2

31. The ______ is the covering of the internal organs of the body and also the lining of the vessels, body cavities, glands, and organs.

a. epithelium

b. connective tissue

c. squamous membrane

d. columnar membrane

Objectives 5 & 6

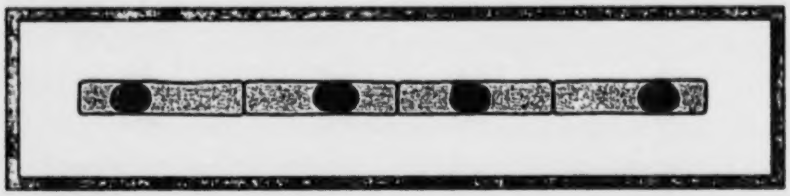
32. ______ tissue consists of a single layer of flat cells that somewhat resemble scales, as shown in the illustration below.

a. Stratified squamous

b. Simple cuboidal

c. Simple columnar

d. Simple squamous



Objective 8

33. What type of connective tissue is located in the nose, ears, trachea, and eustachian tubes and at bone joints and provides firm-but-not-rigid structure and padding between bones?

a. cartilage

b. elastic

c. myeloid

d. lymphatic

Objective 4

34. The body's glands consist of ______ tissue.

a. epithelial
b. connective
c. nerve
d. muscle

Objective 11

35. Nerve-system impulses cannot cross between neurons unless the space between is filled with special chemicals called ______.

a. *nucleotides*
b. *transmitter fluids*
c. *neurotransmitters*
d. *conductive coagulates*

Objective 4

36. Cells that compose the epithelium are compactly arranged with little ______.

a. external cytoplasm
b. intracellular linking
c. intercellular substance
d. contact between cells

Objective 12

37. ______ are able to move so that they can locate and destroy damaged tissue and invading cells and organisms.

a. Microglia
b. Astrocytes
c. Oligodendrocytes
d. Ependyma

Objective 22

38. ______ is an abnormality in organ development in which there is an increase in the size of the organ caused by an increase in the size of its cells.

a. Atrophy
b. Hypertrophy
c. Hypotrophy
d. Anatrophy

Objective 24

39. A wound caused by a force that does not break the skin but is sufficient to cause damage to subdermal tissues is a ______.

    a. crush wound
    b. contusion
    c. puncture wound
    d. perforated wound

Objective 29

40. ______ is a type of wound disruption in which the layers of a surgical wound separate.

    a. Evisceration
    b. Sinus-tract formation
    c. Dehiscence
    d. Eventration

Objective 22

41. ______ is a developmental failure of an organ resulting in the absence of an organ or tissue.

    a. Atrophy
    b. Aplasia
    c. Anaplasia
    d. Hyperplasia

Objective 30

42. A clean/contaminated (Class II) surgical wound has an expected infection rate of ______.

    a. 1 to 5 percent
    b. 8 to 11 percent
    c. 15 to 20 percent
    d. 27 to 40 percent

Objective 29

43. A complication to the wound-healing process in which an organ or tissue structure protrudes into a wound site is ______.

    a. herniation
    b. evisceration
    c. eventration
    d. dehiscence

Objective 27

44. In second-intention wound treatment response, healing may produce a weak union with ______ tissue forming in the bottom of the wound and slowly contracting the wound together as it builds up.

   a. connective

   b. muscle

   c. scar

   d. granulation

Objective 26

45. Which of the following statements does NOT describe something that occurs during the lag phase of the healing process?

   a. Exudate containing blood, lymph, and fibrinogen begins clotting and loosely binds the cut edges together.

   b. Fibroblasts multiply rapidly to bridge the wound gap, secreting fiber-forming collagen.

   c. Fibrin, clotting blood, and serum protein dry out, forming a scab to seal the wound.

   d. Leukocytes remove bacteria and damaged tissue debris.

Objective 24

46. An abrasion is a wound ______.

   a. caused by friction between the tissue and a mechanical force

   b. caused by a force that does not break the skin but is sufficient to cause damage to subdermal tissues

   c. in which skin and underlying tissue are partially or completely torn away

   d. none of the above

Objective 17

47. ______ lines the skeletal joints, tendons, and bursae.

   a. Synovial membrane

   b. Cutaneous membrane

   c. Dermis

   d. Skeletal tissue

Objective 20

48. Which of the following organs consists primarily of nerve tissue?

a. heart

b. brain

c. stomach

d. all of the above

Objective 16

49. During a normally relaxed state, the outer membrane of a muscle fiber is ______ charged due to an abundance of ______ ions and the core of the fiber is ______ charged due to an abundance of ______ ions.

a. positively, sodium, negatively, potassium

b. negatively, sodium, positively, potassium

c. positively, potassium, negatively, sodium

d. negatively, potassium, positively, sodium

Objective 14

50. Turning the palm down is ______.

a. dorsiflexion

b. pronation

c. plantar flexion

d. supination

Objective 14

51. Decreasing the angle of a joint is ______.

a. flexion

b. extension

c. adduction

d. abduction

Objective 13

52. ______ tissue is striated, voluntary muscle tissue attached to bones.

a. Cardiac

b. Skeletal

c. Cartilage

d. Visceral

Objective 12

53. ______ form the insulating sheath on neurons in the central nervous system.

a. Microglia

b. Astrocytes

c. Oligodendrocytes

d. Ependyma

Objective 11

54. The______ of one neuron is separated from a ______ of an adjoining neuron by a space called a ______.

a. nephron, axon, dendrite

b. axon, dendrite, synapse

c. dendrite, synapse, nephron

d. synapse, nephron, axon

Objective 4

55. The epithelium always rests on a layer of ______ tissue with a basement membrane between them.

a. nerve

b. muscle

c. connective

d. synovial

Objective 8

56. Which of the following statements is NOT true with regard to bone connective tissue?

a. Bone tissue produces lymph, which is circulated by the lymphatic system.

b. Bone tissue is located in the skeleton.

c. Bone tissue forms bones that support the body.

d. Bone tissue forms bones that protect organs and tissues.

Objective 3

57. Providing a protective barrier against extreme temperatures, environmental contaminants, and invasions by microorganisms while allowing secretion and excretion of wastes is the main function of ______ tissue.

a. epithelial

b. connective

c. nerve

d. muscle

Objective 7

58. ______ tissue lines the blood vessels and the alveoli.

a. Squamous

b. Cuboidal

c. Columnar

d. Stratified

Objective 8

59. ______ tissue is a type of connective tissue located in tendons, ligaments, deep fascia, dermis, and the kidneys; it provides strong, flexible connections and the formation of scars.

a. Reticular

b. Myeloid

c. Fibrous

d. Areolar

Objective 10

60. ______ carry nervous-system impulses to the cell body of a neuron.

a. Axons

b. Nephrons

c. Synapses

d. Dendrites

Objective 8

61. Which of the following statements is NOT correct with regard to the connective tissue blood?

a. Blood tissue transports materials, including oxygen, throughout the body.

b. Blood tissue is located throughout the blood system.

c. Blood tissue combats foreign organisms and cells.

d. Blood tissue forms certain types of white blood cells.

Objective 11

62. ______ carry impulses from the central nervous system to effectors that cause responses in the muscles and glands.

a. Interneurons

b. Motor neurons

c. Sensory neurons

d. Interferent neurons

Objective 9

63. Neuroglia are located in the ______.

a. central nervous system
b. muscular system
c. integumentary system
d. parasympathetic nervous system

Objective 14

64. A movement of a limb away from the midline is ______.

a. flexion
b. extension
c. adduction
d. abduction

Objective 16

65. The point where the neuron terminates on a muscle fiber is referred to as the ______.

a. *synaptic interface*
b. *neuromuscular junction*
c. *neural striation*
d. *fibro-neural terminus*

Objective 14

66. A toe-down movement of the foot at the ankle is ______.

a. dorsiflexion
b. pronation
c. plantar flexion
d. supination

Objectives 17 & 18

67. Which of the following statements is NOT true with regard to mucous membranes?

a. Mucous membranes line cavities and passages that open to the exterior.
b. Mucous membranes consist of connective tissue over epithelial tissue.
c. Mucous membranes form a selective filter that allows some substances to enter the body while keeping others out.
d. Mucous membranes secrete mucus to keep its cells moist, to lubricate its surfaces, and to trap foreign particles.

Objective 22

68. Incomplete development of an organ, which is usually the result of a decrease in the number of cells, is called ______.

a. *hypoplasia*

b. *hyperplasia*

c. *dysplasia*

d. *anaplasia*

Objective 25

69. The redness associated with inflammation is the result of the ______.

a. clots and inflammatory exudate that accumulate around the damaged tissue

b. increased blood flow and pooling of blood at the injury site

c. chemicals that are released by injured and dying cells

d. accumulation of red blood cells along the walls of the blood vessels

Objective 27

70. Which of the following statements is NOT true of first-intention wound treatment?

a. The wound is closed with a suture soon after the incision or trauma.

b. There is no postoperative swelling.

c. There is adequate serous discharge to reduce the chances of infection.

d. There is minimal separation of the wound edges and minimal scarring.

Objective 3

71. ______ tissue binds to other tissue structures to support and organize the body, binds to foreign cells to protect the body, and binds to molecules to transport materials through the body.

a. Epithelial

b. Connective

c. Nerve

d. Muscle

Objective 10

72. ______ carry nervous-system impulses from the cell body of a neuron.

a. Axons

b. Nephrons

c. Synapses

d. Dendrites

Objective 8

73. What type of connective tissue is located along the walls of the large arteries and alveoli in the lungs and helps in maintaining blood pressure in the blood system and in the exhalation of breath in the lungs?

a. reticular

b. elastic

c. adipose

d. areolar

Objective 4

74. There are no ______ within the epithelium.

a. nuclei

b. mitochondria

c. capillaries

d. proteins

Objective 11

75. ______ are located in the central nervous system and support higher-order functions such as thinking and learning.

a. Interneurons

b. Motor neurons

c. Sensory neurons

d. Interferent neurons

Objective 13

76. ______ tissue is smooth, involuntary muscle tissue that lines the walls of hollow organs.

a. Cardiac

b. Skeletal

c. Cartilage

d. Visceral

Objective 14

77. Turning the palm up is ______.

a. dorsiflexion

b. pronation

c. plantar flexion

d. supination

Objectives 17 & 18

78. Which of the following statements is NOT true with regard to a serous membrane?

a. A serous membrane lines the cavities of the body that open to the exterior.

b. A serous membrane provides a visceral layer to cover an organ enclosed in a cavity.

c. A serous membrane provides a parietal layer to line a cavity.

d. A serous membrane secretes serous fluid to serve as a lubricant and pad between visceral and parietal layers.

Objective 26

79. Which of the following statements does NOT describe something that occurs during the maturation phase of the healing process?

a. Tensile strength grows rapidly as the collagen network of fibers builds.

b. Scar tissue forms.

c. The collagen reforms into cross-links that further increase tensile strength.

d. As collagen density increases, the vascular makeup of the site decreases, reducing blood flow in the area so that the color of the site becomes closer to normal.

Objective 21

80. The overall goal of organ-system functions is to ____.

a. shut down the body in the event of an emergency

b. energize the body in the event of an emergency

c. maintain a state of homeostasis in the body

d. provide nutrients to the body

Objective 30

81. Which of the following phrases does NOT describe a characteristic of a clean (Class I) wound?

a. has an expected infection rate of 10 to 15 percent

b. was not subjected to breaks in aseptic technique

c. shows no inflammation

d. did not require entry into alimentary, genitourinary, or respiratory tracts or oropharyngeal cavity

Objective 29

82. The development of channels that permit the escape of purulent materials from pockets of pus and other fluids during the wound-healing process is called ______.

a. acne

b. hematoma

c. hemorrhage

d. sinus-tract formation

Objective 20

83. Which of the following organs consists primarily of simple squamous epithelial tissue, fibrous connective tissue, muscle tissue, and serous membrane?

a. heart

b. brain

c. stomach

d. lungs

Objective 23

84. Which of the following statements is NOT true concerning a surgical incision?

a. A surgical incision is a smooth-sided wound.

b. A surgical incision is a separation of intact tissue by a surgeon.

c. A surgical incision can cause trauma from a high-energy source.

d. A surgical incision is made by a surgeon using aseptic technique.

Objective 4

85. The epithelium always rests on a layer of connective tissue with a basement ______ between them.

a. organ

b. membrane

c. structure

d. tissue

Objective 8

86. ______ tissue is a type of connective tissue located in the spleen, lymph nodes, and bone marrow; it functions to filter harmful substances from the blood and lymph.

a. Myeloid

b. Cartilage

c. Fibrous

d. Reticular

Objectives 5 & 6

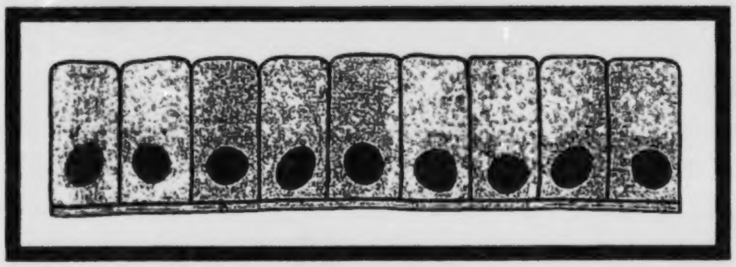
87. ______ tissue consists of a single layer of cells that somewhat resemble rectangular boxes, having one dimension that is longer than the others, as shown in the illustration below.

   a. Simple squamous

   b. Simple cuboidal

   c. Simple columnar

   d. Stratified squamous



Objective 11

88. ______ carry signals from receptors in the skin, skeletal muscles, joints, and organs to the central nervous system.

   a. Interneurons

   b. Motor neurons

   c. Sensory neurons

   d. Interferent neurons

Objective 14

89. A movement of a limb toward the midline of the body is ______.

   a. flexion

   b. extension

   c. adduction

   d. abduction

Objective 15

90. The response of muscle tissue to stimulation by the nervous system is ______.

   a. plantar flexion

   b. dorsiflexion

   c. neuromuscular excitability

   d. rotation

Objective 16

91. The ______ membrane of the muscle fiber has receptors that are sensitive to ACh.

    a. sarcolemma

    b. sarcomere

    c. transverse

    d. oblique

Objective 21

92. The organs have ______ mechanisms that send signals to the central nervous system about the conditions that they monitor.

    a. reflex

    b. motorsensory

    c. feedback

    d. neurotransmitter

Objective 30

93. An infected (Class IV) wound ______.

    a. involved exposure to a perforated organ, such as a bowel

    b. required entry that resulted in gross spillage or contamination from the gastrointestinal tract or entry into the biliary tract with infected bile present, or entry into genitourinary tract with urine present or similar contamination

    c. required entry into alimentary, genitourinary, or respiratory tracts or oropharyngeal cavity under controlled conditions

    d. did not require entry into alimentary, genitourinary, or respiratory tracts or oropharyngeal cavity

Objective 14

94. A movement that increases the angle of a joint is ______.

    a. flexion

    b. extension

    c. adduction

    d. abduction

Objective 16

95. As long as the motor impulses continue to a muscle, the muscle will remain contracted in a condition known as ______.

    a. *pronation*

    b. *flexion*

    c. *tetanus*

    d. *traction*

Answers to Module Review

1. b
2. d
3. b
4. b
5. d
6. a and d
7. c
8. c
9. a
10. a
11. a
12. b
13. a
14. a
15. c
16. b
17. d
18. d
19. b
20. d
21. d
22. a
23. a
24. d
25. a
26. a
27. c
28. c
29. a
30. d
31. a
32. d
33. a
34. a
35. c
36. c
37. a
38. b
39. b
40. c
41. b
42. b
43. a
44. d
45. b
46. a
47. a
48. b
49. a
50. b
51. a
52. b
53. c
54. b
55. c
56. a
57. a
58. a
59. c
60. d
61. d
62. b
63. a
64. d
65. b
66. c
67. b
68. a
69. b
70. c
71. b
72. a
73. b
74. c
75. a
76. d
77. d
78. a
79. a
80. c
81. a
82. d
83. a
84. c
85. b
86. d
87. c
88. c
89. c
90. c
91. a
92. c
93. a
94. b
95. c

Anatomy and Physiology

Module Set I
Introduction
To Anatomy
and Physiology

MAVCC

N311002
01-014709

Surgical Technology

Anatomy and Physiology

Module Set I:
Introduction to Anatomy and Physiology

Student Edition

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Module Set I: Introduction to Anatomy and Physiology

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Module 1: Organization of the Human Body

Module Set I: Introduction to Anatomy and Physiology
Module 1: Organization of the Human Body

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Module Set I: Introduction to Anatomy and Physiology
Module 1: Organization of the Human Body

PREREQUISITES:
None

Learning Activities Sheet

Student name ______________________________

DIRECTIONS Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objectives 1 through 14.

☐ 5. **Research** Online resources to learn more about the organization of the human body. Your instructor will list several web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 6. **Take** Written Test provided by your instructor.

☐ 7. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, repeat steps 4 through 6.

☐ 8. **Do** Assignment Sheet 1, "Practice Critical Thinking: Use Directional Terms to Describe Surgical Incisions."

☐ 9. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 10. If the evaluation is not satisfactory, repeat step 8.

☐ 10. **Study** Student Supplement 1, "Anatomy and Physiology Terms," and Student Supplement 2, "Anatomical Terms."

☐ 11. **Do** Assignment Sheet 2, "Define Medical Terms."

☐ 12.	Stop	Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 13. If the evaluation is not satisfactory, repeat steps 10 and 11.
☐ 13.	Check	With your instructor for any additional assignments to be completed.
☐ 14.	Do	Additional assignments your instructor lists below. ____________________ ____________________ ____________________
☐ 15.	Take	Module Review provided by your instructor.
☐ 16.	Stop	Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.
☐ 17.	Stop	Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheets, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

Module Set I: Introduction to Anatomy and Physiology
Module 1: Organization of the Human Body

Module Objective Sheet

UNIT OBJECTIVE

After completing this module, you should be able to use anatomical terms to identify the general regions of the body, name the major body structures, and list the major organs and structures in the major organ systems. You should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

SPECIFIC OBJECTIVES

After completing this module, you should be able to

1. Define the terms *anatomy* and *physiology*.
2. Define the term *anatomical position*.
3. Label the common body planes.
4. Match the directional terms used in anatomy to their correct descriptions.
5. Describe the locating terms used in anatomy.
6. Describe the body positions.
7. List the general regions of the body.
8. State the contents of the major body cavities.
9. Label the quadrants of the abdominopelvic cavity.
10. Match the major abdominopelvic organs to their correct quadrant locations.
11. Label the regions of the abdomen.
12. List the major body structures in order of increasing complexity.
13. Match the major organ systems to their correct functions.
14. List the major organs and structures in each of the major organ systems.
15. Practice critical thinking: use directional terms to describe surgical incisions. (Assignment Sheet 1)
16. Define medical terms. (Assignment Sheet 2)

Information Sheet

OBJECTIVE 1

Define the terms *anatomy* and *physiology*.

1. **Anatomy** (uh-nat´-uh-me)—The scientific study of the structure of an **organism** that describes the size, shape, construction, and relative positions of the **organs** in the body
2. **Physiology** (fiz-e-awl´-uh-je)—The scientific study of the functions of an organism that describes how the organs work independently and in relation to the whole organism

✔ **NOTE:** A key to success in the medical profession is an understanding of how the human body is structured and how its parts function individually and together.

KEY TERMS

Organism (or´-guh-niz-uhm)—A living person, animal, or plant

Organ (or´-guhn)—A special structure within the body that is arranged in an organized manner to perform a specific function

OBJECTIVE 2

Define the term *anatomical position*.

- **Anatomical** (an-uh-tawm´-i-kuhl) **position**—A position of the body in which a person stands erect, facing directly forward, feet pointed forward and slightly apart, arms hanging down at the sides with the palms facing forward; a standard method of viewing the body so that the anatomy can be consistently described

✔ **NOTE:** Figures 1 through 3 on the next page show a person posed in anatomical position. Three standard views provide perspectives of the anatomical position: anterior (ventral, front) view, lateral (side) view, and posterior (dorsal, back) view.

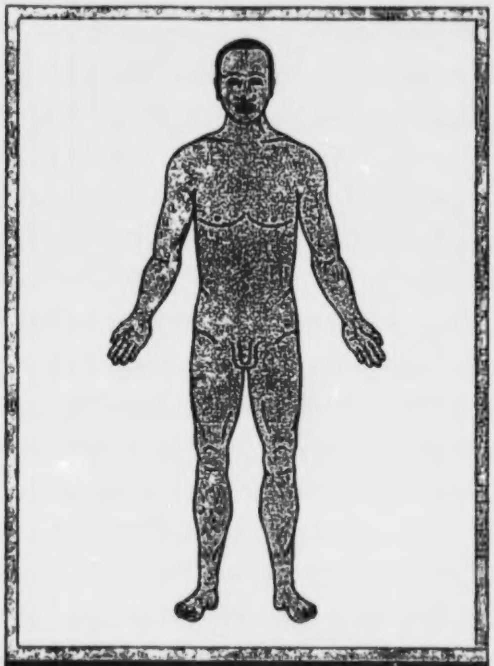


Figure 1
Anatomical position: Anterior view

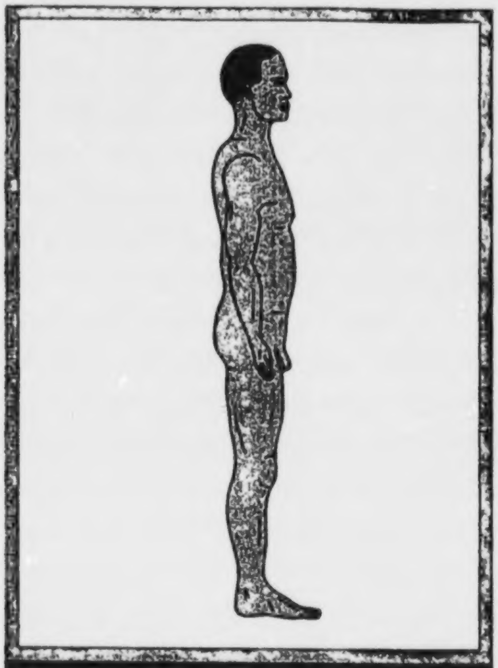


Figure 2
Anatomical position: Lateral view

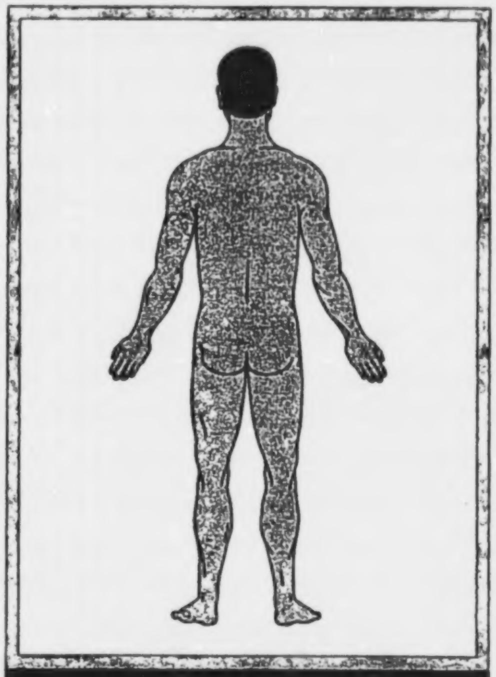


Figure 3
Anatomical position: Posterior view

OBJECTIVE 3

Label the common body planes.

✔ **NOTE:** Because anatomy and physiology deal with internal as well as external features of the body, it is helpful to be able to describe the internal views of the body, as if the body were divided into parts. These views are referred to as *planes* and can be thought of as a straight slice through the body at a particular angle relative to anatomical position. Figures 4 through 8 illustrate the five common body planes: (1) **median plane**, (2) **sagittal plane**, (3) **coronal plane**, (4) **transverse plane**, and (5) **oblique plane**.

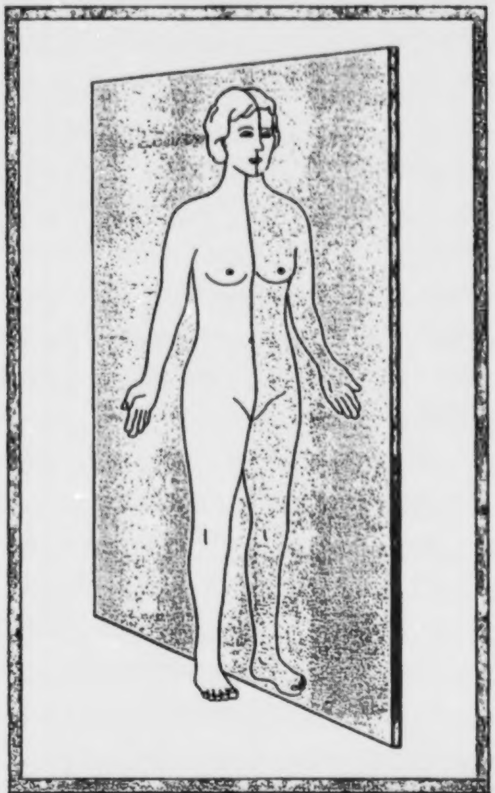


Figure 4
Common body planes: Median plane

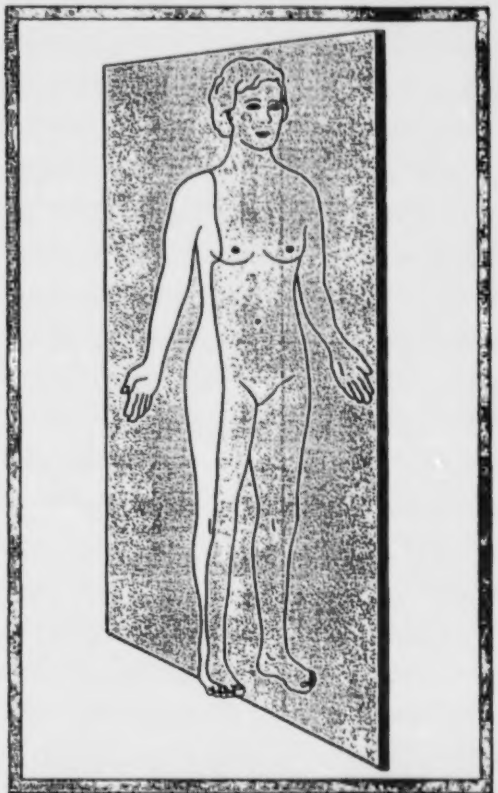


Figure 5
Common body planes: Sagittal plane

KEY TERMS

Median plane (med´-e-uhn plan´)—A lengthwise plane running through the midline of the body from front to back and dividing the body into equal right and left halves

✔ **NOTE:** The median plane is also referred to as the *midline plane* or *mid-sagittal plane.*

Sagittal (saj´-uht-uhl) plane –A lengthwise plane running parallel to the median plane but not through the midline and dividing the body into unequal left and right parts

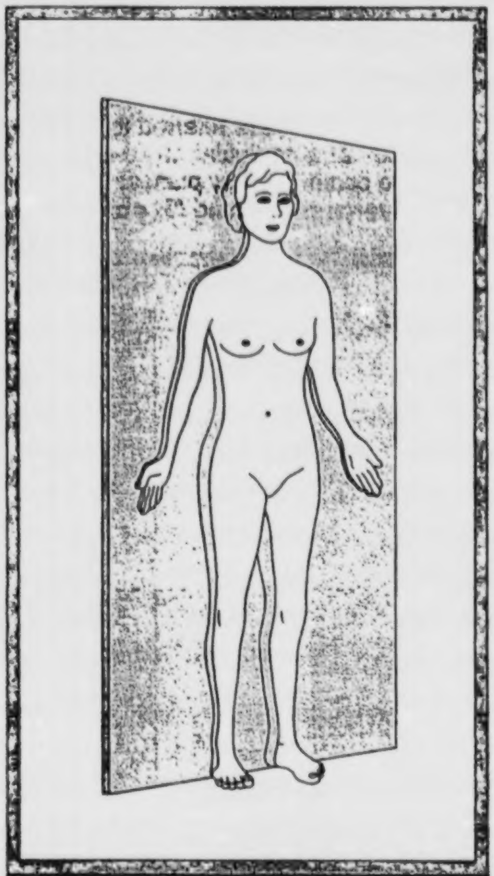


Figure 6
Common body planes: Coronal plane

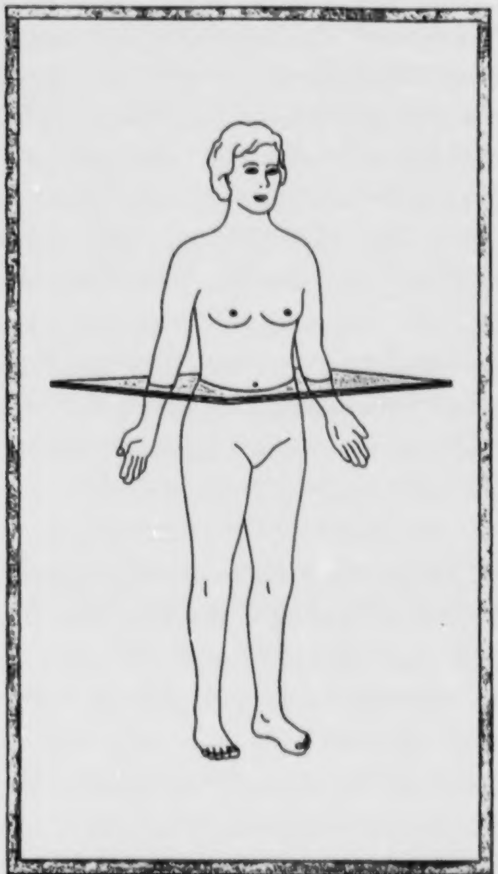


Figure 7
Common body planes: Transverse plane

KEY TERMS

Coronal (kuh-ron´-uhl) **plane** —A lengthwise plane running from side to side and dividing the body into front and back parts

✔ **NOTE:** A coronal plane is also called a *frontal plane*. A coronal plane that passes through an organ creates a longitudinal section of the organ.

Transverse (tranz´-vuhrs) **plane** —A horizontal plane passing through the body from front to back and dividing the body into equal upper and lower parts

✔ **NOTE:** A transverse plane is also called a *horizontal plane* or *cross-sectional plane*. A transverse plane passing through an organ creates a cross section of the organ.

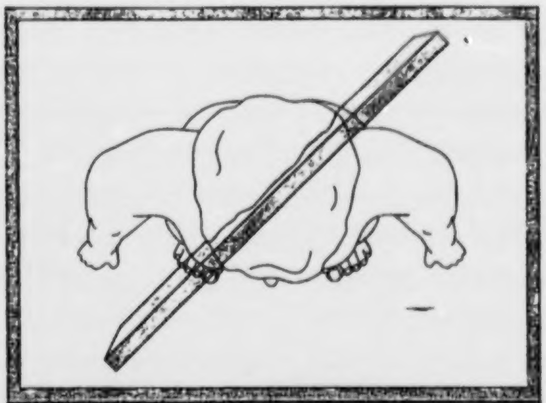


Figure 8

Common body planes: Oblique plane

KEY TERM

Oblique (o-blek´) **plane**—A lengthwise plane passing through the body at a 45-degree angle to a sagittal plane or to the median plane

OBJECTIVE 4

Match the directional terms used in anatomy to their correct descriptions.

✔ **NOTE:** Medical personnel often must indicate the location of anatomical features, such as tumors or injuries. The easiest way of describing such locations is to refer to them in relation to a fixed body part. The following terms are commonly used to describe an anatomical position in relation to body parts. Figure 9 on page 13 illustrates many of these directional terms.

1. **Superior** (su-pir´-e-uhr)—More toward the head

   Example: The knee is superior to the ankle.

   ✔ **NOTE:** Another term for superior is *cephalic.*

2. **Inferior** (in-fir´-e-uhr)—Farther from the head

   Example: The wrist is inferior to the elbow.

   ✔ **NOTE:** Another term for inferior is *caudal.*

3. **Anterior** (an-tir´-e-uhr)—More toward the front of the body

   Example: The nose is anterior to the ears.

   ✔ **NOTE:** Another term for anterior is *ventral.*

4. **Posterior** (paw-stir´-e-uhr)—More toward the backside of the body

   Example: The heel is posterior to the toes.

   ✔ **NOTE:** Another term for posterior is *dorsal.*

5. **Proximal** (prawk´-suh-muhl)—Nearer to a point of reference

   Example: The neck is proximal to the head as compared to the stomach.

6. **Distal** (dis´-tuhl)—Farther from a point of reference

   Example: The elbow is distal to the hand as compared to the wrist.

7. **Medial** (med´-e-uhl)—Closer to the midline of the body

   Example: The eyes are medial as compared to the ears.

8. **Lateral** (lat´-uh-ruhl)—Farther from the midline of the body

   Example: The hips are lateral as compared to the navel.

9. **Internal** (in-tuhrn´-uhl)—Below the surface

   Example: The heart and lungs are internal.

10. **Exterior** (ek-stir´-e-uhr)—On the surface

    Example: The skin is exterior.

11. **Deep** (dep´)—Away from the surface

    Example: The kidneys are deep.

12. **Superficial** (su-puhr-fish´-uhl)—Near the surface

    Example: A rash of the skin is superficial.

13. **Central** (sen´-truhl)—At or near the middle

    Example: The nose is central on the face.

14. **Peripheral** (puh-rif´-uh-ruhl)—At or near the edge

    Example: The toes are peripheral to the foot.

15. **Parietal** (puh-ri´-uht-uhl)—At the wall of a body cavity

    Example: The mucosa that line most body cavities are parietal.

16. **Visceral** (vis´-uh-ruhl)—Within a body cavity

    Example: Most internal organs are visceral.

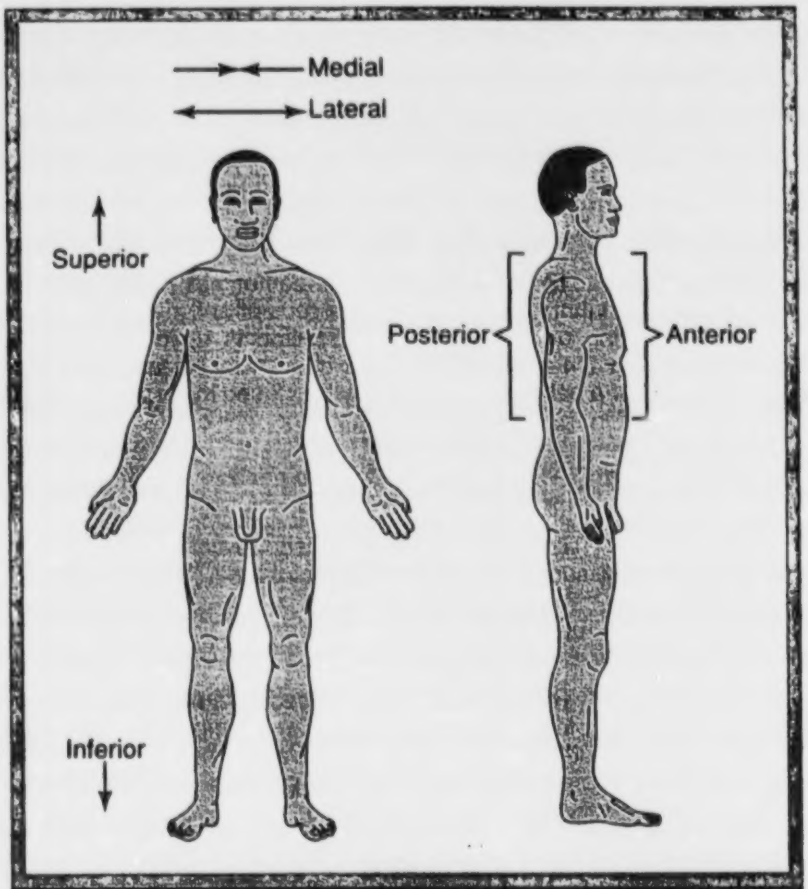


Figure 9
Directional terms

OBJECTIVE 5

Describe the locating terms used in anatomy.

1. **Cephalic** (suh-fal´-ik)—Referring to the head or to the head end of a structure

   ✔ **NOTE:** Another term for cephalic is *cranial* (kra´-ne-uhl).

2. **Caudal** (kawd´-uhl)—Referring to the tail or tail end of a structure
3. **Palmar** (pal´-muhr)—Referring to the palm of the hand
4. **Plantar** (plant´-uhr)—Referring to the sole of the foot
5. **Greater curvature** (grat´-uhr kuhr´-vuh-chuhr)—Referring to the outer and longer portion of a curved structure
6. **Lesser curvature** (les´-uhr kuhr´-vuh-chuhr)—Referring to the inner and shorter portion of a curved structure

OBJECTIVE 6 **Describe the body positions.**

1. **Erect** (i-rekt')—Standing or sitting upright

   ✔ **NOTE:** The erect position is used during portions of an **examination** and during procedures that do not require the patient to be fully **anesthetized**.

2. **Supine** (su-pin')—Lying down face up

   ✔ **NOTE:** The supine position is sometimes referred to as the *dorsal recumbent* (ri-kuhm'-buhnt) *position*. Because recumbent means lying down, dorsal recumbent means lying on the back. This position is used during **surgeries** of the anterior anatomy, such as abdominal, pelvic, or facial surgery. For some procedures, such as delivery of a baby, the patient may be placed in a position with the head slightly raised in a position called the *semi-recumbent position*.

3. **Prone** (pron')—Lying down on the stomach

   ✔ **NOTE:** The prone position is used to perform surgery on the posterior surface of the body, such as the back, the rectal area, and the posterior of the legs.

4. **Lateral** (lat'-uh-ruhl)—Lying on one side

   ✔ **NOTE:** The lateral position is used for surgeries that focus on a structure that is more to one side than to the middle. For example, a patient might be placed lateral on the left side if a surgery were to be performed on the right kidney. Most thoracic surgeries are performed in the lateral position.

KEY TERMS

Examination (ig-zam-uh-na'-shuhn)—An evaluation of a person's health based on appearance, the person's feelings and behavior, and the status of indicators of health such as temperature, blood pressure, and body chemistry

Anesthetize (uh-nes'-thuh-tiz)—To create in a patient a loss of sensation, with or without a loss of consciousness; to create a condition of anesthesia (an-uhs-the'-zhuh) in a patient; to administer an anesthetic (an-uhs-thet'-ik)

Surgery (sur'-juhre)—A medical procedure intended to correct physical defects, repair injuries, or treat diseases, especially through the use of medical instruments

✔ **NOTE:** There are many types of surgical procedures, or operations, performed for a number of diverse purposes. One of the principal reasons for studying anatomy and physiology is to assess the normal structure and functioning of the body in order to determine when surgery may be required and the nature of the procedure that might benefit the patient.

OBJECTIVE 7 **List the general regions of the body.**

1. **Head**

✔ **NOTE:** The head (see Figure 10) includes the area of the body above the neck, principally the cranium and face along with internal structures. Of obvious importance is the brain, but the head's internal structures also include the components of the mouth, nose, eyes, ears, as well as several **glands**.

2. **Trunk**

✔ **NOTE:** The trunk (see Figure 10) is also called the *torso* (tor´-so) and consists of what is commonly considered to be a person's body, excluding the head, arms, and legs. Thus, the trunk includes the neck, back, chest (thorax), abdomen, pelvis, and **perineum**. The majority of the **vital organs** are contained in the trunk.

3. **Limbs**

✔ **NOTE:** The limbs (see Figure 10), or *extremities* (ik-strem´-uht-ez), consist of the arms, legs, hands, and feet. They are important in movement but do not contain vital organs. Thus, a person may lose an extremity without it being **fatal**. However, due to the amount of blood that flows through the extremities, injury to an arm or leg can lead to bleeding that is severe enough to cause death.

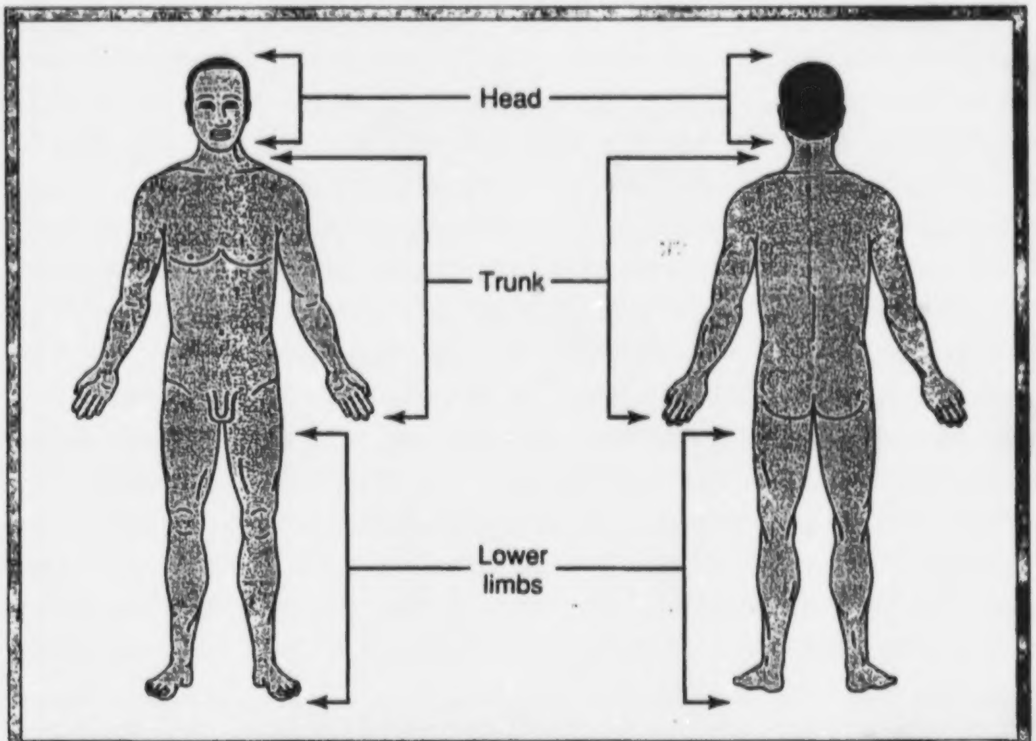


Figure 10
General regions of the body

KEY TERMS

Gland (gland´)—Any of the various structures within the body that produce specific chemicals to help with the functions of the body

✔ **NOTE:** There are glands in all parts of the body. You will study about them in relation to the systems that they support. Additionally, in a later module you will study a body system called the *endocrine* (en´-duh-kruhn) *system*, which consists primarily of glands and related structures.

Perineum (per-uh-ne´-uhm)—The area of tissue behind the pelvis that gives passage to the urinary and genital ducts and to the rectum

Vital organ (vit´-uhl or´-guhn)—An organ that must function properly in order for the life of the organism to continue

✔ **NOTE:** The heart, liver, and brain are vital organs. If these organs do not function properly, the person will die. Some organs are critical but not vital. For example, a person can live with one lung or one kidney. Other organs—the spleen and eyes for example—improve a person's ability to function but do not directly result in death if they stop functioning or are removed from the body.

Fatal (fat´-uhl)—Resulting in death

OBJECTIVE 8

State the contents of the major body cavities.

✔ **NOTE:** The internal volume of the body is not solid. Under the framework formed by the skin, the muscles, and the skeleton are hollow areas called *cavities*. These cavities contain many of the organs and other structures that support life. Often the organs of a **system** will be contained within a single cavity. The information provided in this objective introduces you to the major body cavities and provides you with basic information about their contents. Some of the structures named will be familiar to you, while you may be less acquainted with others. At this point of your studies, you are not expected to have a thorough comprehension of the structure and functions of these organs—after all, the purpose of this course is to provide you with that knowledge. This objective and those that follow are intended to allow you to begin making these associations. The remainder of your studies will build on this foundation.

KEY TERM

System (sis´-tuhm)—A group of organs and related structures that work together to perform a common function

✔ **NOTE:** The functioning of the body is supported by a number of systems that perform specific purposes (see Objectives 13 and 14). Each system consists of one or more organs and additional structures that connect these organs and tie them to other systems.

1. **Cranial** (kra´-ne-uhl) **cavity**—Brain and pituitary gland

2. **Spinal** (spin´-uhl) **cavity**—Spinal cord

   ✔ **NOTE:** The cranial cavity and spinal cavity are sometimes referred to collectively as the *dorsal* (posterior or back) *cavity* (see Figure 11).

3. **Pleural** (plur´-uhl) **cavities**—One lung in each

4. **Pericardial** (per-uh-kard´-e-uhl) **cavity**—Heart

5. **Mediastinal space** (med-e-uh-stin´-uhl spas´)—Thymus gland, trachea, esophagus, bronchi, ends of the vena cavae, beginning of the aorta

   ✔ **NOTE:** The two pleural cavities, the pericardial cavity, and the mediastinal space are referred to collectively as the *thoracic cavity* (see Figure 11).

6. **Abdominal** (ab-dawm´-uhn-uhl) **cavity**—Stomach, liver, gallbladder, spleen, pancreas, most of the small and large intestines, kidneys

7. **Pelvic** (pel´-vik) **cavity**—Urinary bladder, sex organs, part of the large intestine, including the cecum, appendix, and rectum

   ✔ **NOTE:** The pelvic cavity roughly begins on a line along the level of the iliac crests.

   ✔ **NOTE:** The abdominal cavity and the pelvic cavity are referred to collectively as the *abdominopelvic cavity*. The thoracic cavity (the cavity above the diaphragm) and the abdominopelvic cavity (the cavity below the diaphragm) are sometimes referred to collectively as the *ventral* (anterior or front) *cavity* (see Figure 11).

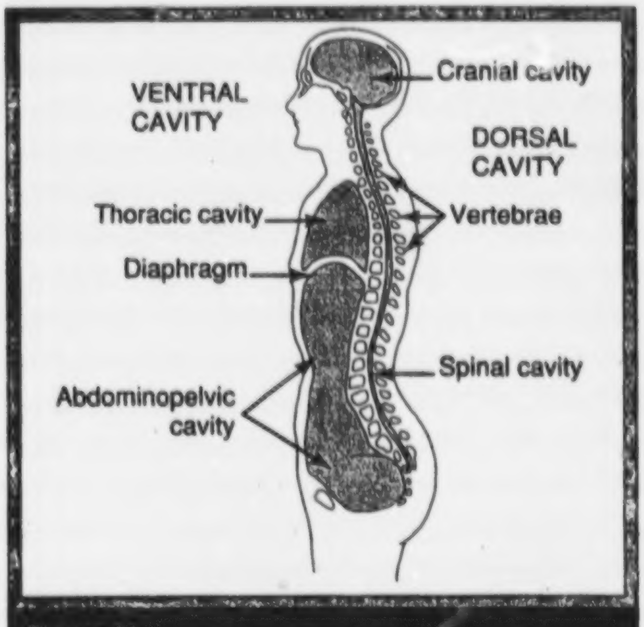


Figure 11
Major body cavities

OBJECTIVE 9

Label the quadrants of the abdominopelvic cavity.

✔ **NOTE:** A quadrant is one-fourth of a given area. The external surface over the abdominopelvic cavity can be viewed in quadrants designated as upper and lower halves and right and left halves. This approach is convenient for indicating the location of the underlying organs and structures. For example, severe pain in the right lower quadrant may indicate appendicitis, an **inflammation** of the appendix, an extension to the large intestine. An important point to remember about how the quadrants are labeled is that left and right refer to the person's left and right sides. Thus, as you view a person with pain in the right lower quadrant, that location will be to your left.

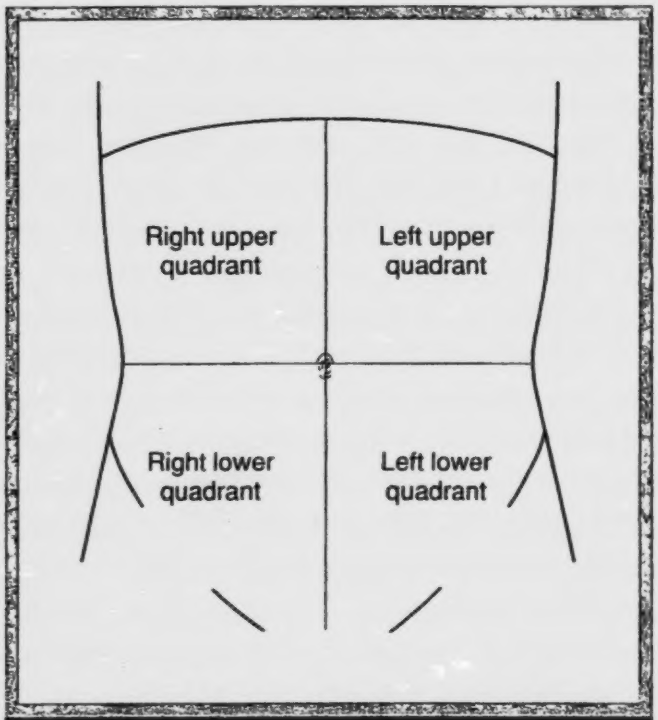


Figure 12
Quadrants of the abdominopelvic cavity

KEY TERM

Inflammation (in-fluh-ma´-shuhn)—A group of reactions exhibited by tissue when exposed to irritants; the reactions may include swelling, heat, pain, and other signs of irritation

✔ **NOTE:** Indications such as heat, pain, and swelling (an enlargement of a body structure) are called *symptoms* (sim{p}´-tuhms). Symptoms can provide a great deal of information about a possible anatomical or physiological problem. The severity of the symptom and its location, whether the symptom is continuous or comes and goes, and the presence of other symptoms can help medical professionals assess a patient's condition and the effectiveness of treatment.

OBJECTIVE 10

Match the major abdominopelvic organs to their correct quadrant locations.

1. **Right upper quadrant** (RUQ) (see Figure 13)
   - Part of the small intestine, including the descending duodenum
   - Upper ascending colon
   - Most of the liver
   - Gallbladder
   - Bile ducts
   - Head of the pancreas
   - Right adrenal gland
   - Right kidney
   - Upper part of the right ureter

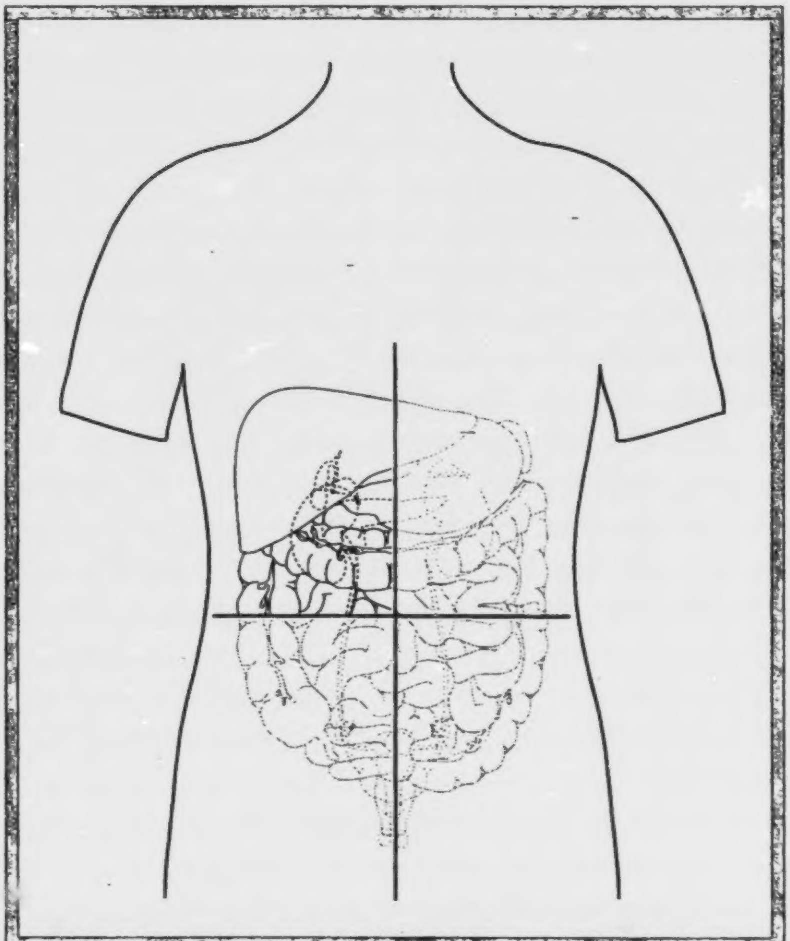


Figure 13
Major organs of the right upper abdominopelvic cavity

2. **Left upper quadrant** (LUQ) (see Figure 14)
   - Ascending part of the duodenum
   - Upper descending colon
   - Left half of the transverse colon
   - Spleen
   - Small part of the liver
   - Left adrenal gland
   - Left kidney
   - Upper part of the left ureter
   - Stomach

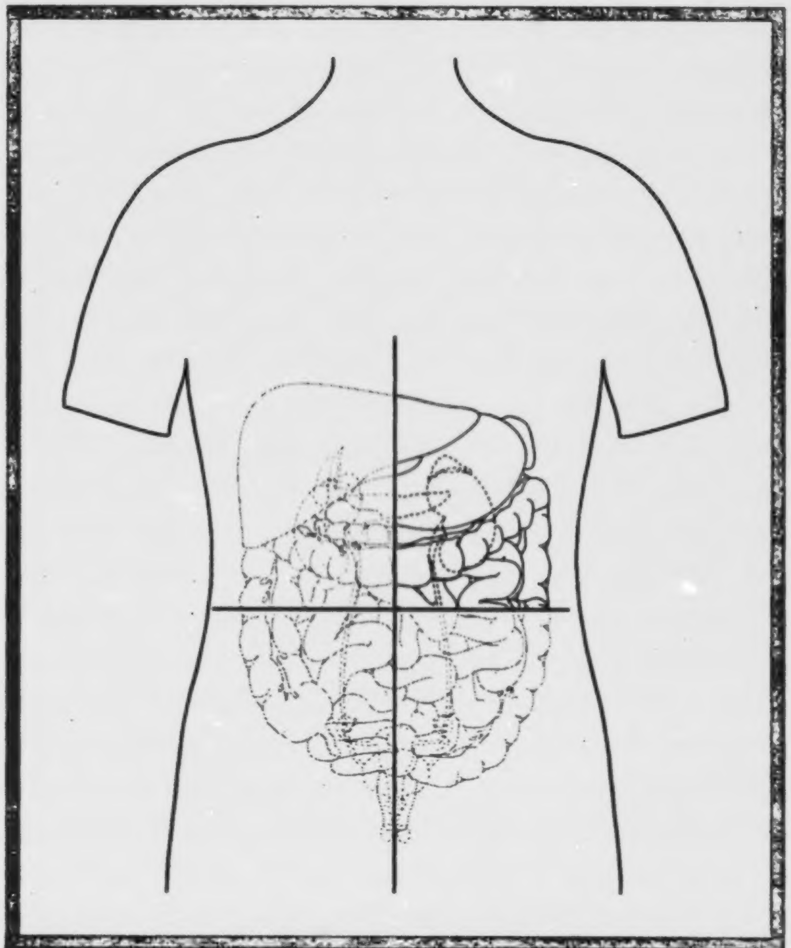


Figure 14
Major organs of the left upper abdominopelvic cavity

3. **Right lower quadrant** (RLQ) (see Figure 15)
   - Lower ascending colon
   - Cecum
   - Appendix
   - Lower right ureter
   - Terminal ileum
   - Part of the urinary bladder
   - Sex organs

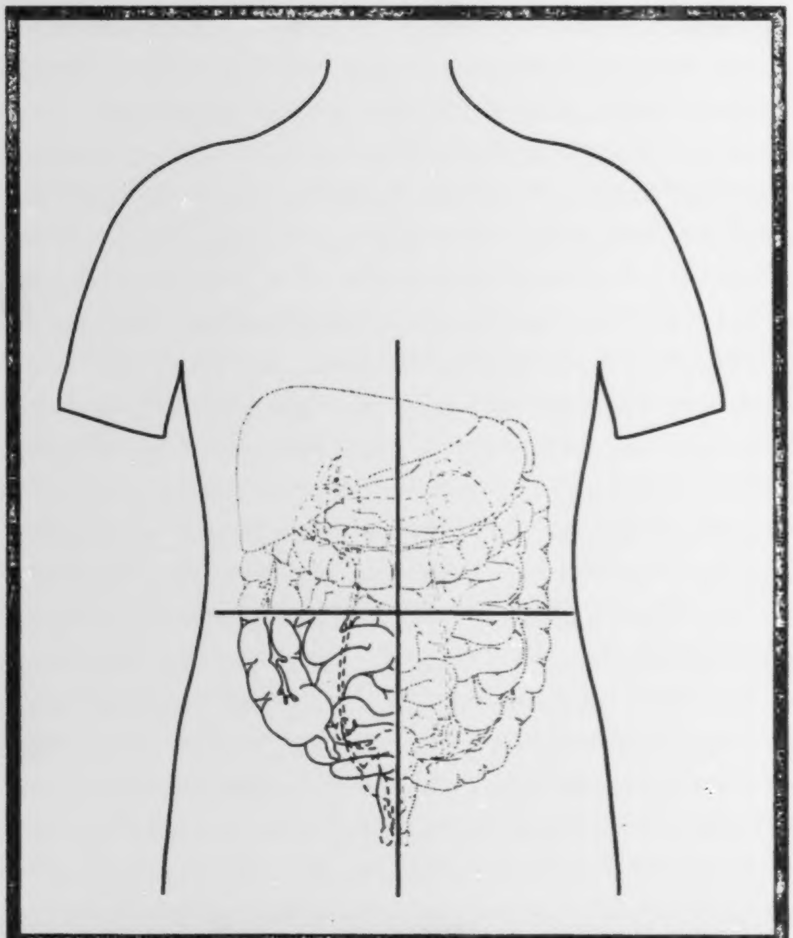


Figure 15
Major organs of the right lower abdominopelvic cavity

4. **Left lower quadrant** (LLQ) (see Figure 16)
   - Lower descending colon
   - Small intestine (part of ileum)
   - Part of the urinary bladder
   - Sex organs

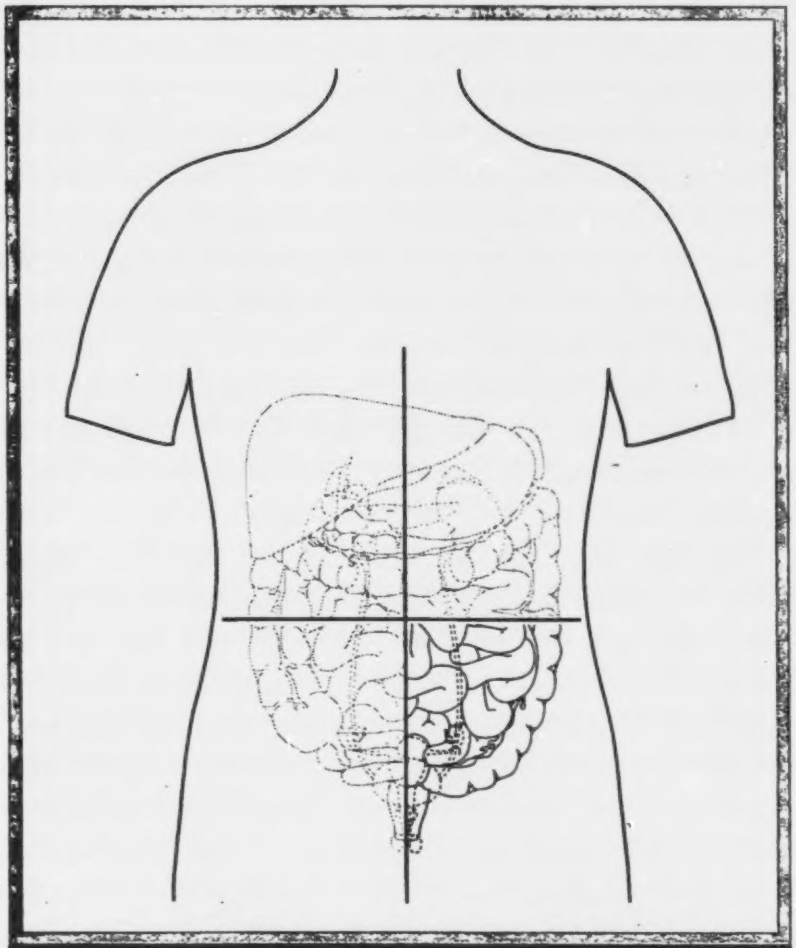


Figure:16
Major organs of the left lower abdominopelvic cavity

OBJECTIVE 11 **Label the regions of the abdomen.**

✔ **NOTE:** The abdominal portion of the abdominopelvic region can be further divided into areas that allow more-precise identification of structures and symptoms. The nine regions of the abdomen (see Figure 17 on the next page) are centered around the **umbilicus**. The area around the umbilicus is the center segment of the abdominal regions and is called the *umbilical region.* The area above it is called the *epigastric region*, from two Greek terms meaning "over the stomach." The area below the umbilical region is termed the *hypogastric* or "beneath the stomach" region. The areas to the left and right of the three medial regions are named for their locations relative to features of the skeleton. The upper sections lie over the lower ribs, below the rib cage, and are called *hypochondriac*, meaning "below the **cartilage**." The middle lateral regions are called the *lumbar regions* because they are anterior to the lumbar region of the back. Finally, the lower left and right regions lie over the hips and take the name of the hip bone, *iliac.*

KEY TERMS

Umbilicus (uhm-buh-li´-kuhs)—The point at which the umbilical cord joined the fetus to the mother's womb during pregnancy; commonly referred to as the *navel* or *belly button*

Cartilage (kart´-uhl-ij)—A type of body tissue that forms the skeleton of the developing fetus, most of which is converted to bone after birth

✓ **NOTE:** Some cartilaginous structures remain even in adults. These include structures in the nose and ears and on the joint surfaces of bones.

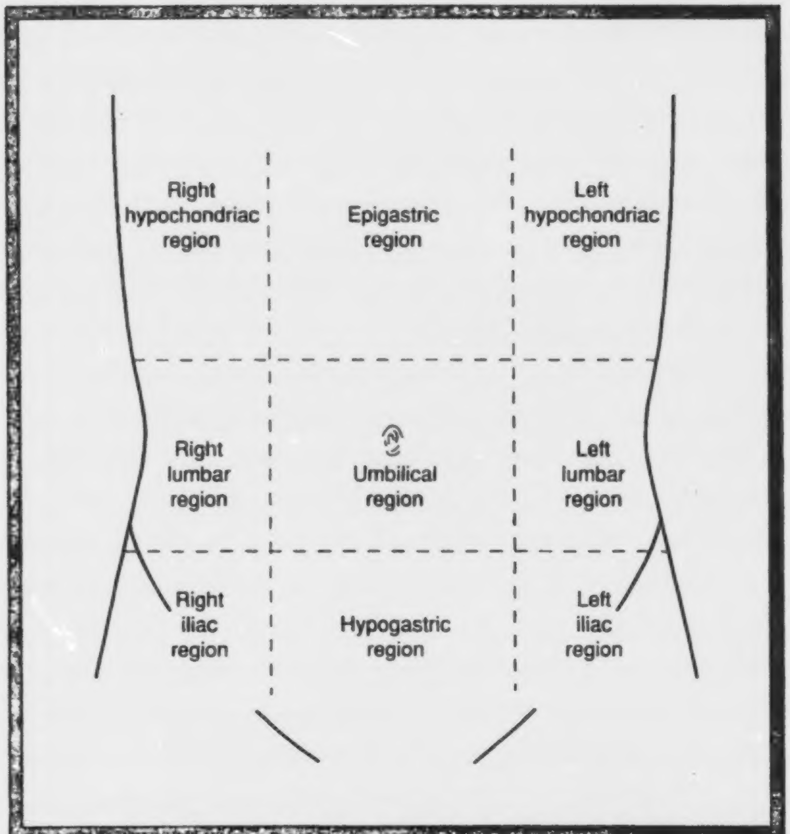

Right hypochondriac region
Epigastric region
Left hypochondriac region
Right lumbar region
Umbilical region
Left lumbar region
Right iliac region
Hypogastric region
Left iliac region

Figure 17
Nine regions of the abdomen

OBJECTIVE 12

List the major body structures in order of increasing complexity.

✔ **NOTE:** Like all substances, the human body is composed of atoms, which in turn make molecules. Atoms and molecules form chemical elements and compounds. Certain combinations of chemicals exhibit the characteristic called *life*, which means that that combination of chemicals can move, grow, convert food into energy, and reproduce. The smallest bunches of chemicals that exhibit life are called *cells*. Cells include bacteria and organisms such as amoebas. All plants and animals, including humans, are made of cells. Cells form more-complex structures called *tissue*. Tissue can be organized to perform a specific function within a plant or animal. This organized structure is called an *organ*. Organs that work together in the performance of related functions are called *organ systems* or simply *systems*. The integrated systems thus make up the living creature called an *organism*.

1. **Cell**
2. **Tissue**
3. **Organ**
4. **Organ system**
5. **Organism**

KEY TERM

Structure (struhk´-chuhr)—A part of the body, such as the heart, a bone, a gland, a cell, or a limb

OBJECTIVE 13

Match the major organ systems to their correct functions.

✔ **NOTE:** As you learned in Objective 8, a system is a group of organs and related structures that work together to perform a common function. The 12 major body systems and their functions in the body are presented below and are further discussed and illustrated in Objective 14.

1. **Integumentary system** (in-teg´-yuh-ment-uh-re sis´-tuhm)—Protects the organism from injury, disease, and infection; aids in the regulation of temperature, the excretion of wastes, and the reception of sensations
2. **Skeletal** (skel´-uht-uhl) **system**—Provides the framework for the body and works to protect and support the body
3. **Muscular** (muhs´-kyuh-luhr) **system**—Provides for body movement and support
4. **Nervous** (nuhr´-vuhs) **system**—Coordinates body activities by receiving, interpreting, and conducting messages to all the other systems of the body
5. **Special senses** (spesh´-uhl sens´-es)—Function in receiving sensations such as sight, smell, hearing, and taste

6. **Digestive** (di-jes´-tiv) **system**—Receives, breaks down, and absorbs food substances and excretes waste products

7. **Circulatory** (suhr´-kyuh-luh-tor-e) **system**—Transports materials throughout the body by carrying oxygen and nutrients in the blood to all the cells of the body and carrying away the waste products of the cells

8. **Respiratory** (res´-puh-ruh-tor-e) **system**—Takes in oxygen from the air and gives off carbon dioxide, which is produced by cell metabolism

9. **Urinary** (yur´-uh-ner-e) **system**—Serves in removing waste products from the blood and in excreting wastes in the form of urine

10. **Reproductive** (re-pruh-duhk´-tiv) **system**—Involved with reproduction and childbirth

11. **Endocrine** (en´-duh-kruhn) **system**—Serves to regulate various body functions through glands that secrete hormones directly into the blood to slow down or increase the activity of the cells

12. **Immune** (im-yun´) **system**—Provides protection against disease and infection

OBJECTIVE 14

List the major organs and structures in each of the major organ systems.

1. **Integumentary system**—Skin, hair, nails, duct glands (see Figure 18 on page 26)

2. **Skeletal system**—Bones, joints, cartilage, connective tissue (see Figure 19 on page 26)

3. **Muscular system**—Skeletal, smooth, and cardiac muscles (see Figure 20 on page 26)

4. **Nervous system**—Brain, spinal cord, peripheral nerves (see Figure 21 on page 26)

5. **Special senses**—Eyes, ears, nose, taste buds (see Figure 22 on page 27)

6. **Digestive system**—Mouth, pharynx, esophagus, stomach, large and small intestines, accessory organs such as the gallbladder and pancreas (see Figure 23 on page 27)

7. **Circulatory system**—Heart, blood vessels, blood, lymphatic tissues (see Figures 24-a and 24-b on page 27)

8. **Respiratory system**—Lungs, nose, pharynx, larynx, trachea (see Figure 25 on page 28)

9. **Urinary system**—Kidneys, ureter, bladder, urethra (see Figure 26 on page 28)

10. **Reproductive system**—Sex organs and ducts to the outside (see Figures 27-a and 27-b on page 28)

11. **Endocrine system**—Ductless glands (see Figure 28 on page 29)

    Examples: Thyroid, pituitary

12. **Immune system**—White blood cells, antibodies

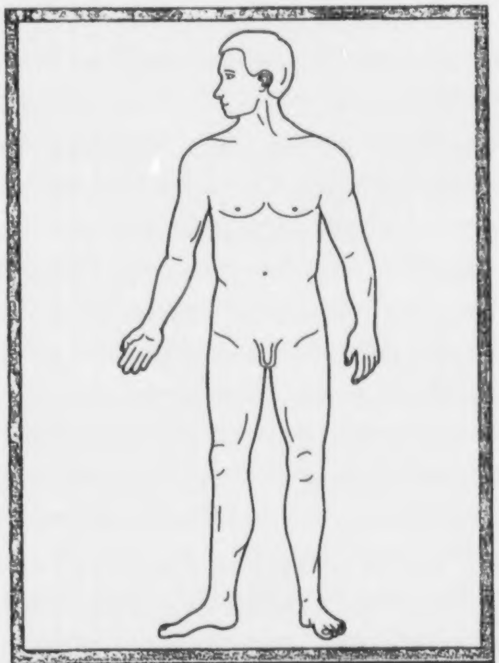


Figure 18
Integumentary system

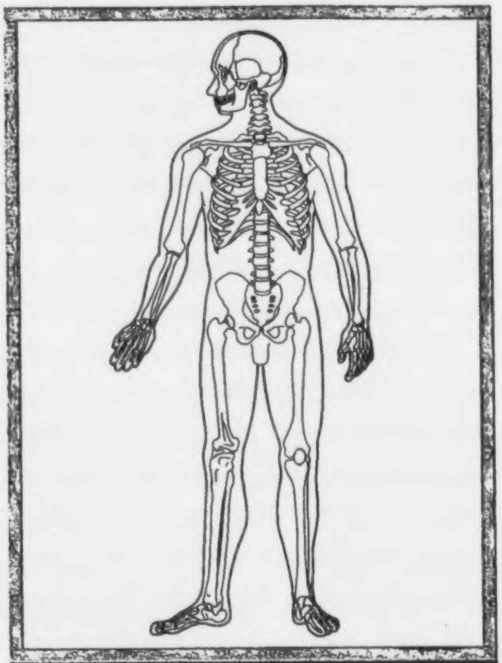


Figure 19
Skeletal system

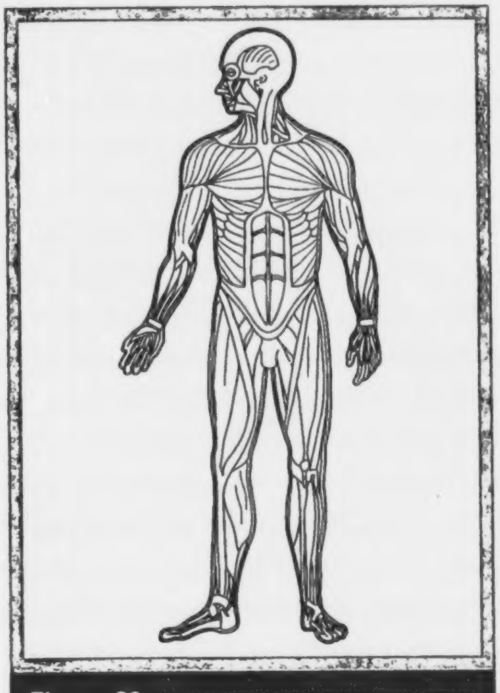


Figure 20
Muscular system

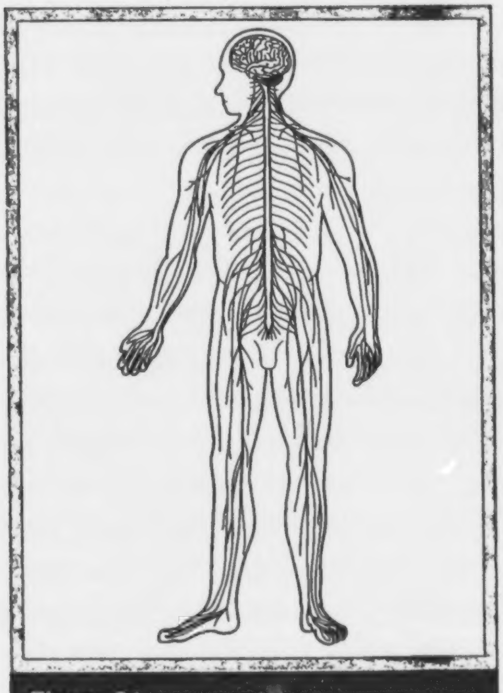


Figure 21
Nervous system

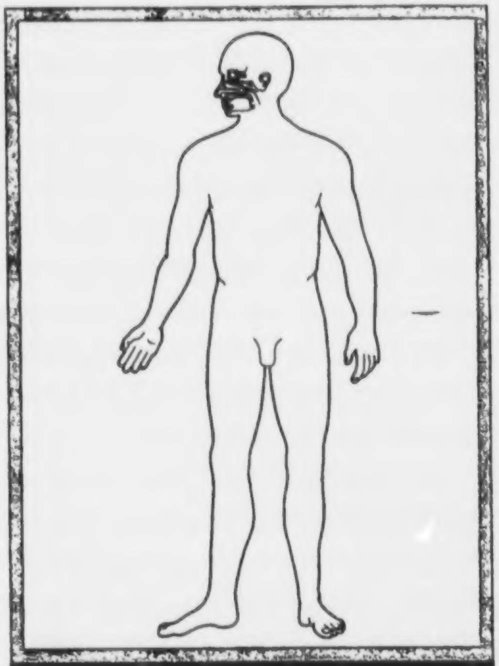


Figure 22
Special senses

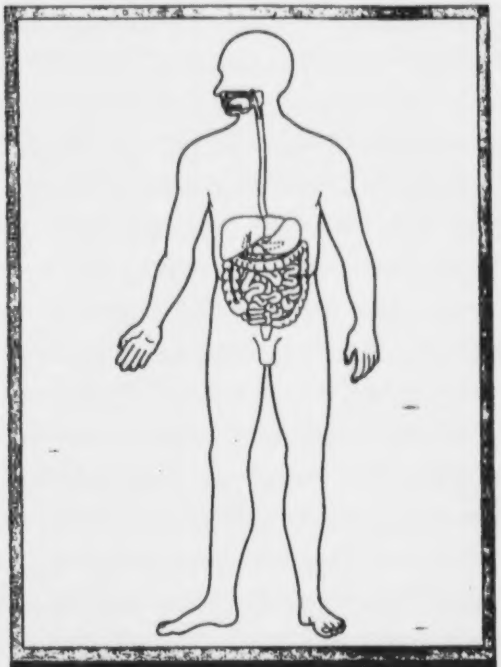


Figure 23
Digestive system

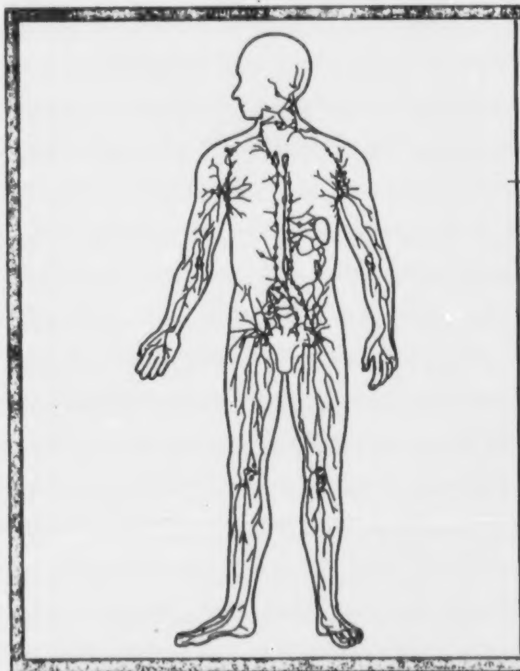


Figure 24-a
Circulatory system (lymphatic)

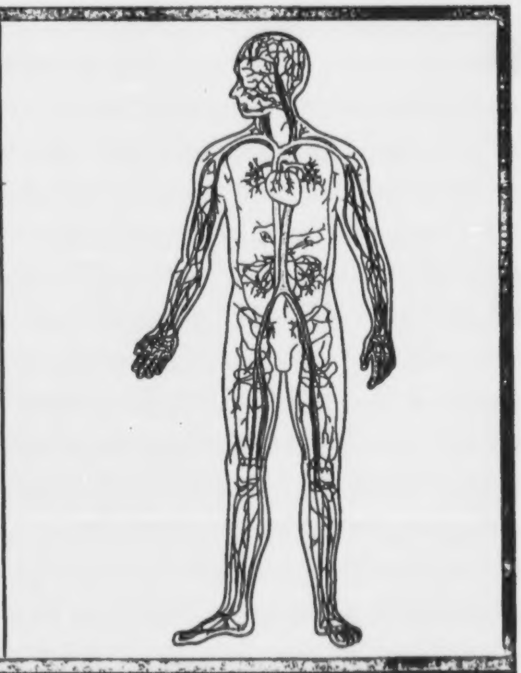


Figure 24-b
Circulatory system (blood)

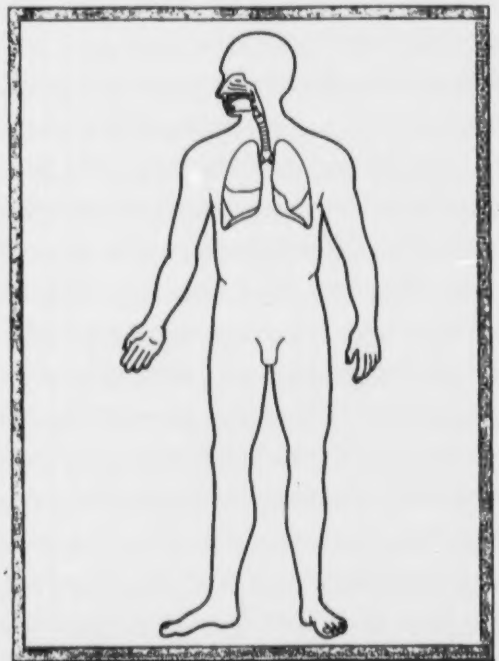


Figure 25
Respiratory system

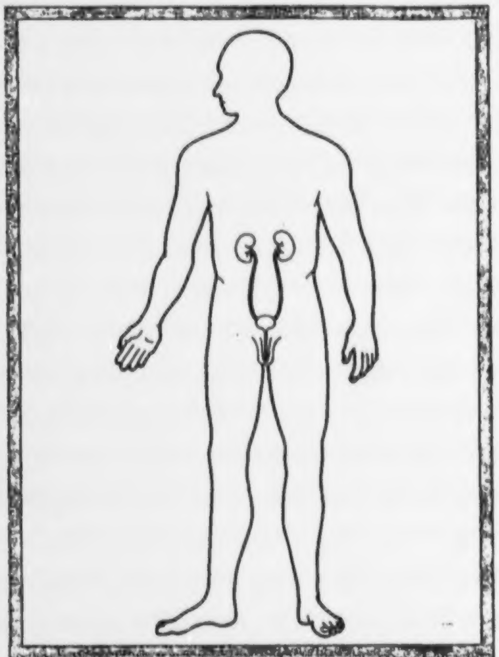


Figure 26
Urinary system

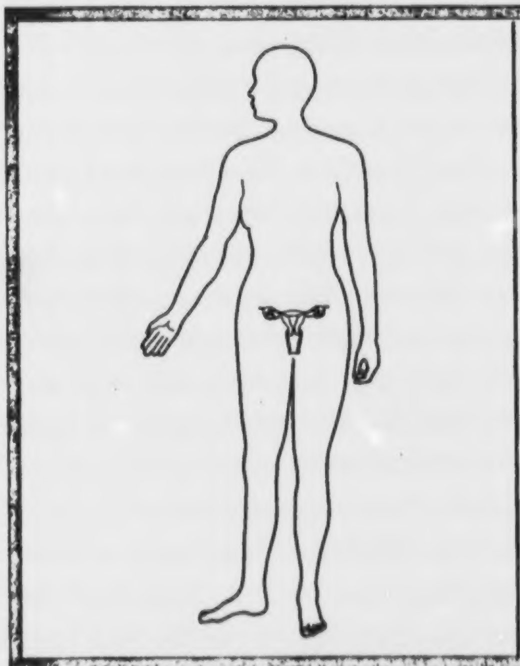


Figure 27-a
Reproductive system (female)

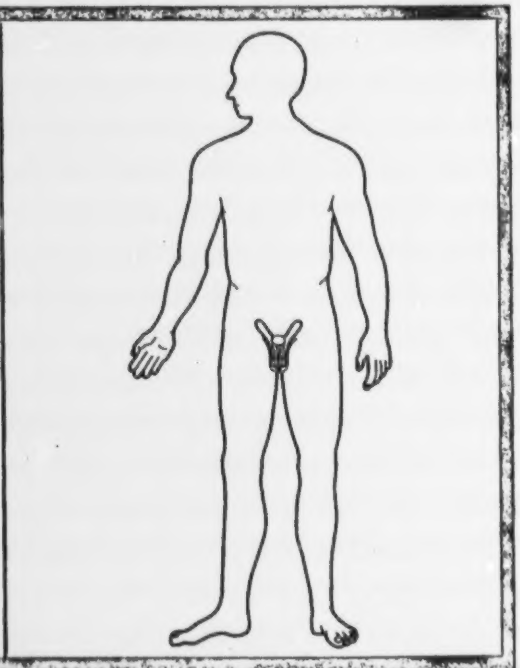


Figure 27-b
Reproductive system (male)

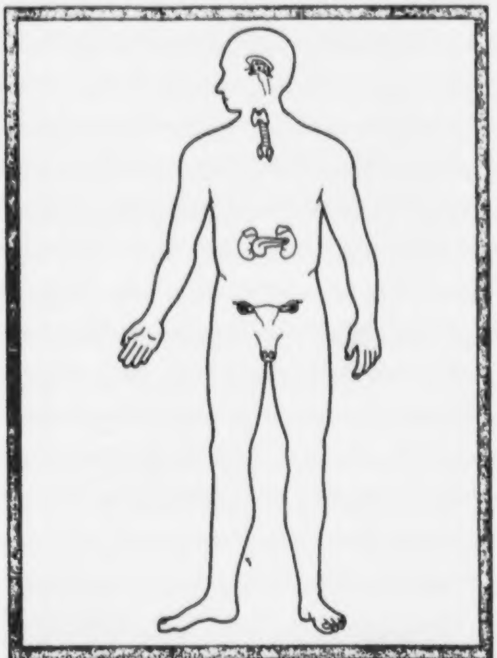


Figure 28
Endocrine system

Student Supplement 1—Anatomy and Physiology Terms

INTRODUCTION

You have learned that anatomy and physiology are the studies of body structures and functions. For the most part, the words used to name body parts are simply descriptions of structure and function. Many of these names describe a body part or its function and indicate its location or relationship to other body parts. But you may not always recognize these terms because many of them are based on foreign words, often Latin. Once you have learned a few key terms, you will be able to decipher the meaning of words that you have never seen.

This student supplement presents a number of terms, many of which you encountered in this module. The table on pages 33 and 34 lists these words, explains important terms and prefixes and suffixes, and provides more words that you will come across in your studies. Prefixes are stems on the front of a word, while suffixes end words. For example, *ascending* is a word that is used in anatomy, as in *ascending colon. Ascending* consists of a prefix (a-), a root word (-scend-), and a suffix (-ing). *A-* comes from a Latin word meaning "up" or "out of," while *scend* comes from a Latin word that means "climb." The *-ing* ending is a common English suffix to show an action or process. Thus, *ascending* describes the fact that this section of the colon makes an upward turn.

Study the terms in this student supplement to help you become familiar with the vocabulary of anatomy and physiology. Use the table of terms as a reference as you continue your studies.

Table 1
Anatomy and Physiology Terms

Application	Term/prefix/suffix	Refers to	Related words
body parts and areas	abdomen	the area between the chest and hips	abdominal, abdominopelvic
	caudal	a tail	cauda equina (literally, *horse's tail*, a branch of nerves)
	cephalic	the head	encephalitis, cephalic vein
	cerebrum	the brain	cerebral cortex, cerebrospinal fluid
	cranial	the head or skull	cranium, craniosacral
	corona	a circle (from Latin for *crown*)	coronary artery, coronal suture
	hemoglobin	a substance in blood (the prefix *hemo-* or *hema-* indicates blood)	hemorrhage, hemophilia, hemorrhoid, hematuria
	hepatic	the liver	hepatic artery, hepatic jaundice, hepatitis
	iliac	a hip	iliac crest, ilium, sacroiliac joint
	lumbar	the lower back	lumbar vertebra, lumbar plexus
	nasal	the nose	nasal septum, nasopharynx
	neuron	a portion of nerve	neuroglia, neuromuscular junction, neurotoxin
	ocular	an eye	occulomotor nerve, orbicularis oculi muscle
	optic	an eye	optic nerve, optic chiasma, myopia
	oral	the mouth	oral cavity, oropharynx
	os	bone	ossification, osteoporosis
	parietal	the wall of a body cavity	parietal lobe, parietal pericardium
	pelvis	the hips	pelvic inlet, abdominopelvic
	pleural	the chest cavity	pleural membrane, pleurisy
	pulmonar	the lungs	pulmonary circulation, cardiopulmonary resuscitation
	rectum	lower end of intestines	rectal fold, rectal thermometer
	renal	the kidneys	renal failure, renal medulla
	sinus	an opening	maxillary sinus, sinusoids
	thora	the chest	thoracic duct, thoracolumbar
	umbilical	the navel	umbilical cord, umbilicus
	urinary	the tract for eliminating urine	ureter, urethra, urea, urinary bladder
	visceral	the organs within a cavity	visceral peritoneum, visceral pleura
directions	ascending	rising up	ascending colon, ascending aorta
	descending	going down	descending colon, descending tract
	distal	farther from the origin	distal convoluted tubule
	dorsal	toward the back	dorsal arch, dorsal cavity, dorsal root
	internal	within	internal carotid artery
	lateral	away from the midline	lateral ventricle, lateral rectus muscle
	peripheral	extending from	peripheral nervous system
	proximal	closer to the origin	proximal convoluted tubule
	sagittal	cut in a straight line (from Latin for *arrow*)	sagittal plane, sagittal suture
	transverse	across	transverse colon, transverse sinus
	ventral	toward the front	ventral cavity, ventral root
comparisons	ante-	before	anterior
	anti-	against, opposing	antibody, antitoxin, antiseptic
	ecto-	outside	ectoderm
	endo-	within	endothelium
	epi-	on, over	epidermis, epigastric
	ex-	out of	external, excrete
	homo-, homeo-	same, unchanged	homeostasis, homozygous

Table 1 (cont.)
Anatomy and Physiology Terms

Application	Term/prefix/suffix	Refers to	Related words
comparisons (cont.)	hyper-	excessive, over	hypertension, hypersecretion
	hypo-	inadequate, beneath	hypochondriac, hyposecretion
	intra-	within	intramuscular
	iso-	equal, balanced	isotonic
	macro-	relatively large	macrophage
	med-	between, in the middle	median, mediastinal
	meta-	next to, beyond	metacarpals
	micro-	relatively small	microscopic
	para-	similar to, resembling	parathyroid, parasympathetic
	peri-	surrounding, outside of	pericardium, peritoneum, perineum
	post-	after, following	posthepatic jaundice, posterior
	pre-	before, preceding	premature birth, premolar
	proto-	early, first	protoplasm
	re-	again	respiratory
	retro-	behind	retroperitoneal
	sub-	below	subcutaneous, sublingual
	super-, supra-	above, greater than	superior, superficial, suprarenal gland
	ultra-	to an extreme, beyond	ultrasound, ultraviolet
numbers, amounts	uni-	one	unit, unicellular, universal donor
	mono-	one	monocyte, monosaccharide
	bi-	two	biceps, bicuspid
	tri-	three	triceps, tricuspid
	quad-	four	quadrant
	poly-	many	polypeptide, polyuria
general	acute	sharp, coming quickly	acute pain, acute illness
	appendicular	attached to	appendicular skeleton
	axial	the main part of	axial skeleton
	corpus	a structure (from Latin for *body*)	corpus luteum, corpuscle
	foramen	a hole (from Latin for a *bored hole*)	foramen magnum, foramen ovale
	fossa	a pit, depression (from Latin for *ditch*)	mandibular fossa
	meatus	a natural body opening (from Latin for *passageway*)	external auditory meatus
	plane, planus	a flat surface (from Latin for *flat*)	frontal plane, sagittal plane
	plexus	a point of interwoven structures (from Latin for *braid*)	sacral plexus, brachial plexus
	pneumo	relating to the respiratory system (from Latin for *air*)	pneumonia, pneumothorax
	terminal	relating to an end point	terminal illness
	torso	the main portion of the body from the shoulders to the hips	torso
plurals	-a	becomes -ae	fossa/fossae, vena/venae
	-um	becomes -a	atrium/atria, bacterium/bacteria
	-us	becomes -i	bacillus/bacilli

Student Supplement 2—Anatomical Terms

INTRODUCTION As you have learned, health-care professionals must become familiar with a special vocabulary. Many of these words are based on Greek, Latin, or other foreign languages. Student Supplement 1 covers a number of these terms, especially those that will help you to understand the location and function of body parts. Additionally, there are specific terms for given areas of the body. This student supplement presents the most-common medical terms for body regions and parts. Because muscles, nerves, bones, blood vessels, and other structures often take their names from their location, knowing these words will help you to more easily learn anatomy and related terms.

Table 1
Anatomical Terms

Term	Related part	Term	Related part
abdominal (ab-dawm´-uhn-uhl)	lower anterior torso	mandibular (man-dib´-yuh-luhr)	jaw
acromial (ak-ro´-me-uhl)	shoulder	mental (ment´-uhl)	chin
antebrachial (ant-e-bra´-ke-uhl)	forearm	nasal (na´-zuhl)	nose
axillary (ak´-suh-ler-e)	armpit	occipital (awk-sip´-uht-uhl)	back of the head
brachial (bra´-ke-uhl)	upper arm	olecranal (o-lek´-ran-uhl)	back of the elbow
buccal (buhk´-uhl)	mouth or cheeks	oral (or´-uhl)	mouth
calcaneal (kal-ka´-ne-uhl)	heel of the foot	orbital (or´-buht-uhl)	eye
cardiac (kard´-e-ak)	heart	otic (awt´-ik)	ear
carpal (kar´-puhl)	wrist	palmar (pal´-muhr)	palm
cephalic (suh-fal´-ik)	head	parietal (puh-ri´-uht-uhl)	crown of the head
cervical (suhr´-vi-kuhl)	neck	patellar (puh-tel´-uhr)	kneecap
coxal (kawk´-suhl)	hip	pectoral (pek´-truhl)	chest
cranial (kra´-ne-uhl)	head	pedal (ped´-uhl)	foot
crural (krur´-uhl)	leg	pelvic (pel´-vik)	area defined by hips
cubital (kyu´-buht-uhl)	elbow	perineal (per-uh-ne´-uhl)	pelvic floor
cutaneous (kyu-ta´-ne-uhs)	skin	plantar (plant´-uhr)	sole of a foot
deltoid (del´-toid)	shoulder	pollex (pawl´-eks)	thumb
dental (dent´-uhl)	the teeth	popliteal (pawp-luh-te´-uhl)	back of a knee
digital (dij´-uht-uhl)	finger or toe	pubic (pyu´-bik)	anterior region of groin
dorsal (dor´-suhl)	upper back		
femoral (fem´-uhruhl)	thigh	pulmonary (pul´-muh-ner-e)	lungs
frontal (fruhnt´-uhl)	forehead	renal (ren´-uhl)	kidneys
gastric (gas´-trik)	stomach	sacral (sak´-ruhl)	base of the spine
gluteal (glut´-e-uhl)	buttocks	sural (sur´-uhl)	calf
hepatic (hi-pat´-ik)	liver	tarsal (tar´-suhl)	ankle
iliac (il´-e-ak)	hip	temporal (tem´-puhruhl)	side of the head
inguinal (in´-gwuhn-uhl)	groin	thoracic (thuh-ras´-ik)	chest
lingual (ling´-gwuhl)	tongue	umbilical (uhm-bil´-i-kuhl)	navel
lumbar (luhm´-buhr)	small of the back	volar (vo´-luhr)	palm
mammary (mam´-uh-re)	breast		

OBJECTIVE 15

Assignment Sheet 1—Practice Critical Thinking: Use Directional Terms to Describe Surgical Incisions

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
• Directions were followed	_______
• Directional terms were used correctly	_______
• Descriptions accurately and clearly describe the surgical incision	_______
Overall rating	_______

Evaluator's comments ____

____

____

INTRODUCTION

The terms used to describe human anatomy are extremely helpful in the surgical setting. The location of surgical sites can be accurately described through the use of the terminology that you have studied in this module. Similarly, surgical procedures can be described using the same terms and a few simple measurements.

One of the basic surgical skills is incision planning: Where will the incision be made, how long, how deep, in what direction, in what shape? These are all questions the surgeon must consider. One of the basic principles in making incisions is to use the *relaxed skin tension lines*. These lines define the natural stresses of the skin in its role of containing muscles and organs and allowing normal movement of the body. An incision made along a relaxed skin tension line will heal faster, is less likely to be torn open after surgery, and will leave less of a scar. Figure 1 and Figure 2 on the next page show the relaxed skin tension lines for the face and body.

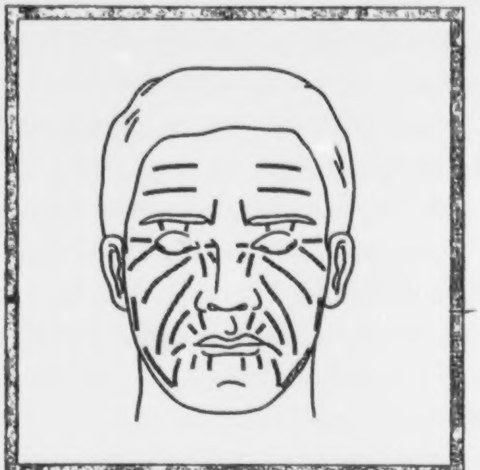


Figure 1
Relaxed skin tension lines of the face

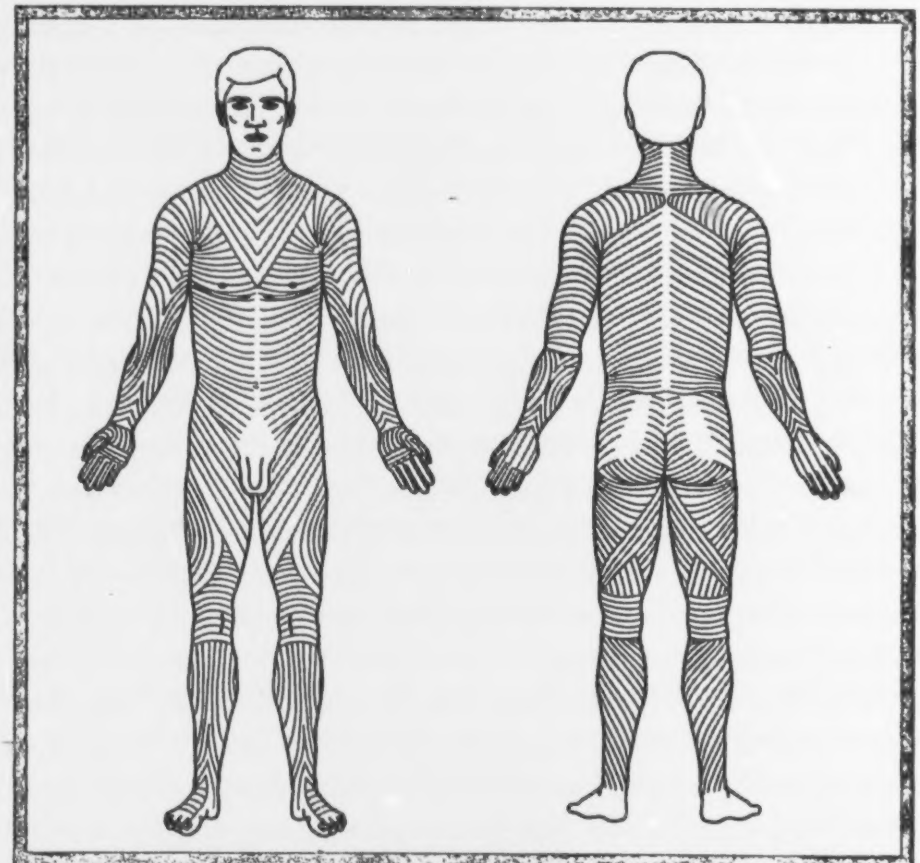


Figure 2
Relaxed skin tension lines of the body

EXERCISE

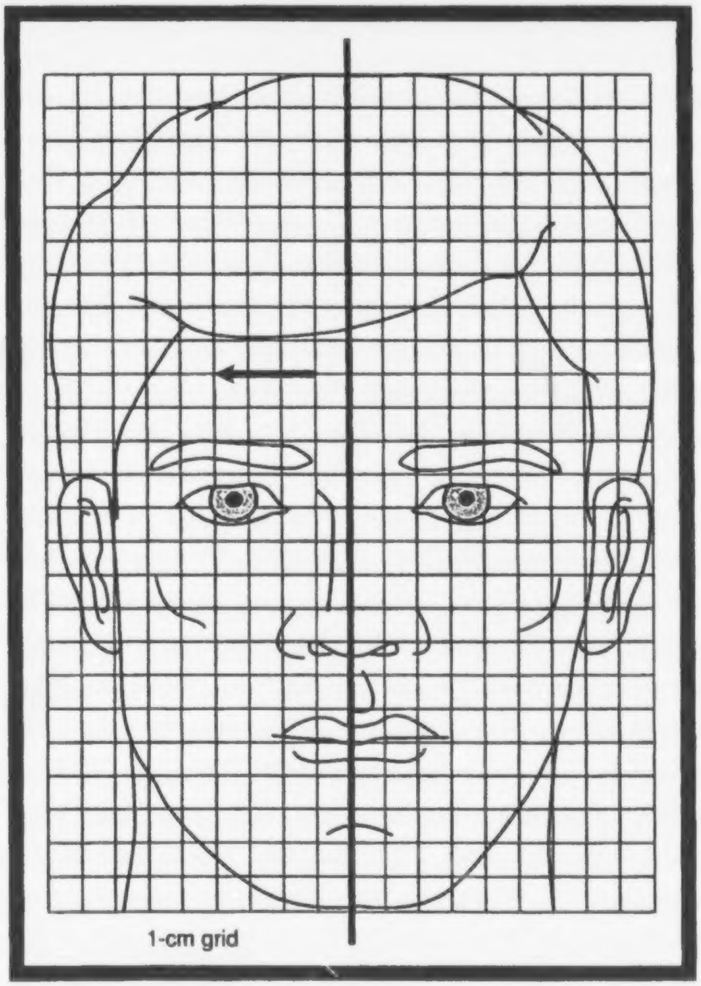
ACTIVITY CHECKLIST

Put a checkmark on the blank line before each activity below as you complete it.

______ 1. Review the objectives in the Information Sheet.

______ 2. In each problem in the exercise in this assignment sheet, you will be provided with an illustration of an incision. Use the directional terms you have learned in this module and the information provided in the illustration to describe each incision. Write your description on the blank lines provided under each illustration. See the example below.

Example:

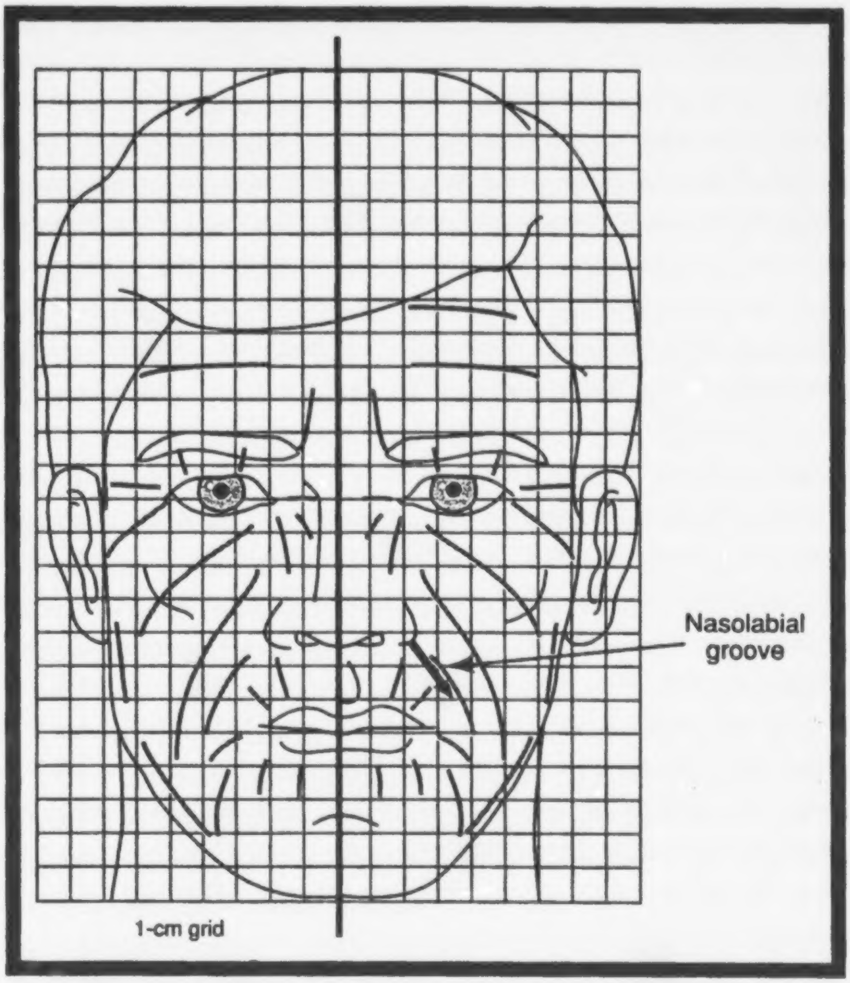


Your description of the incision illustrated:

Begin the incision 1 cm to the right of the median plane and 2 cm superior to the eyebrow; proceed laterally 3 cm.

______ 3. Complete the assignment and give it to your instructor for evaluation.

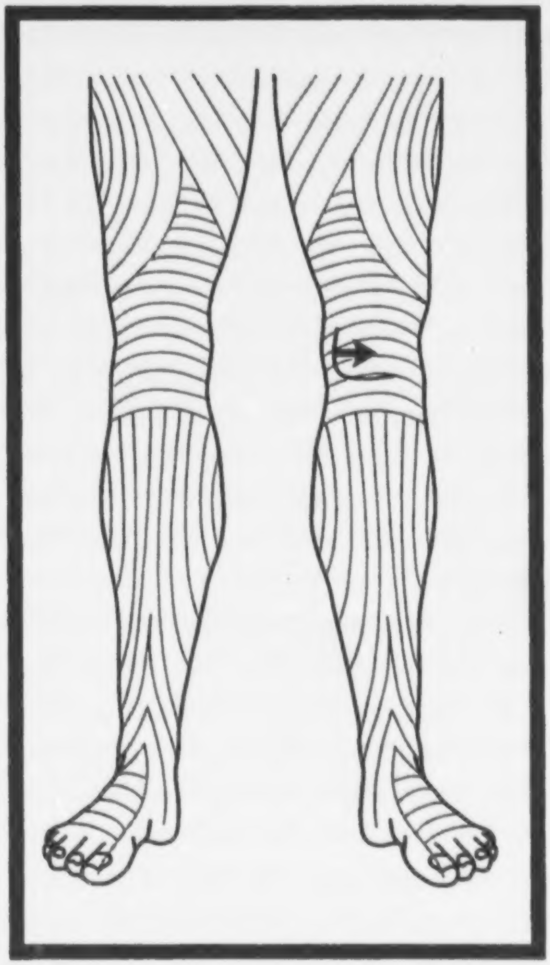
PROBLEM 1


Nasolabial groove
1-cm grid

Your description of the incision illustrated:

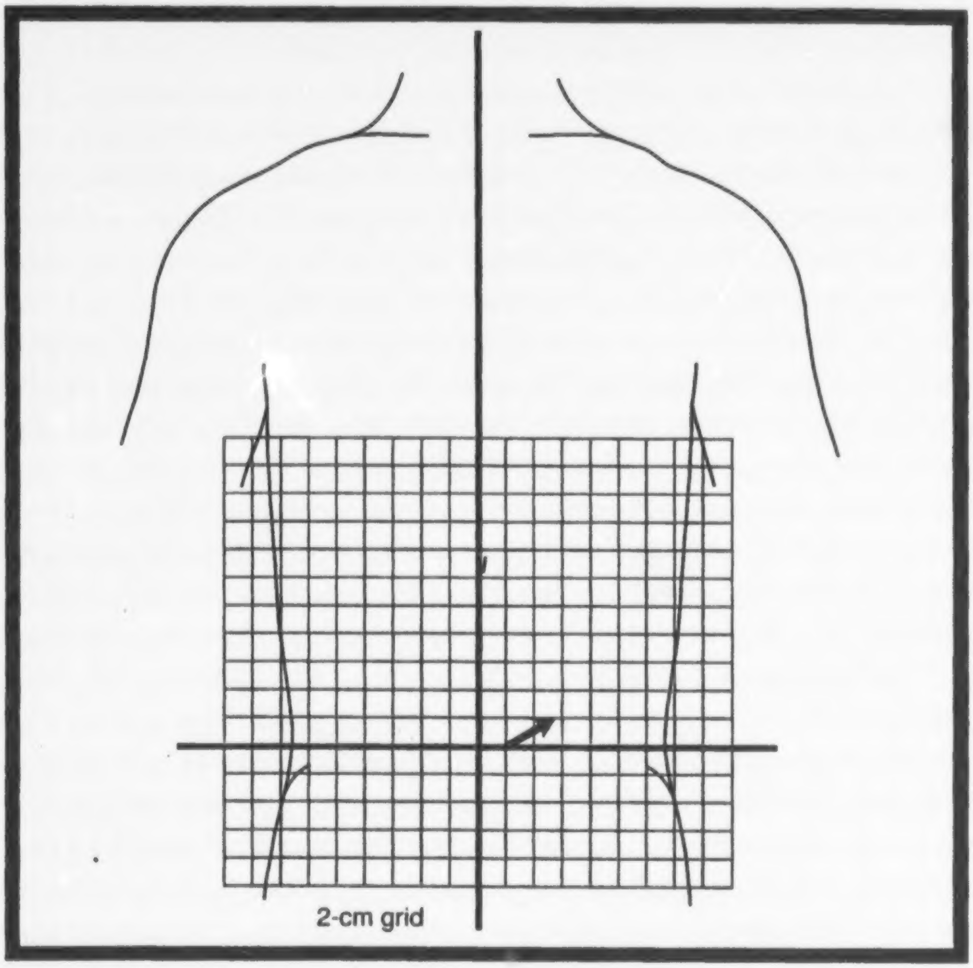
362

PROBLEM 2



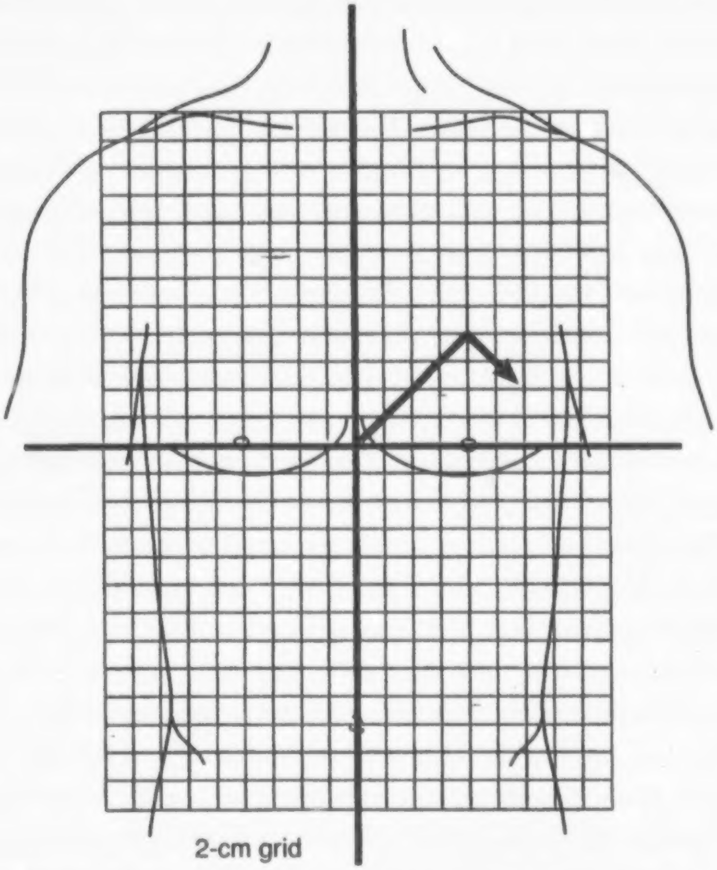
Your description of the incision illustrated:

PROBLEM 3



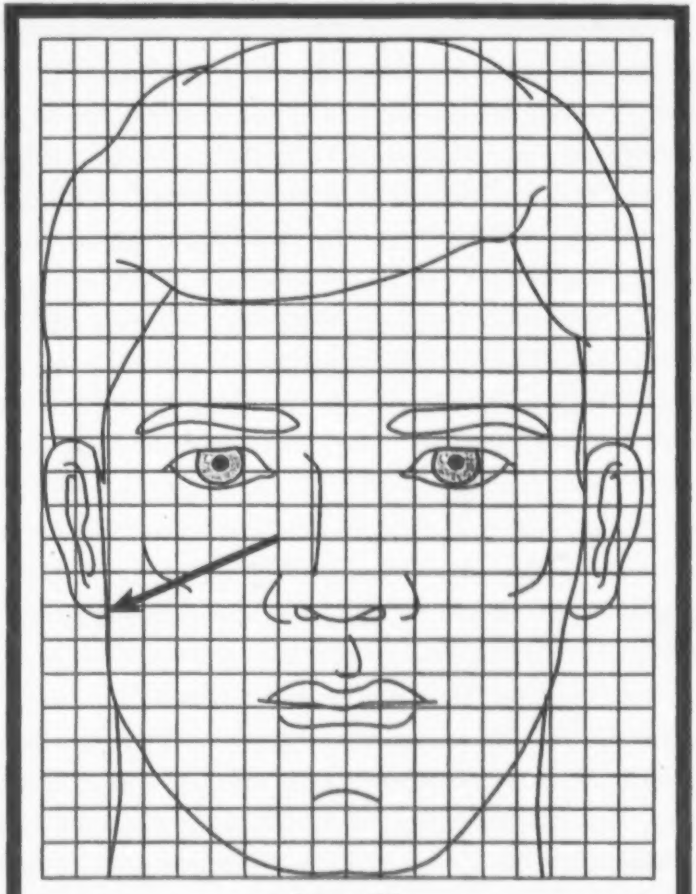
Your description of the incision illustrated:

PROBLEM 4



Your description of the incision illustrated:

PROBLEM 5



2-cm grid

Your description of the incision illustrated:

366

OBJECTIVE 16

Assignment Sheet 2—Define Medical Terms

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
• Directions were followed	______
• Medical terms were defined correctly in the context of the statements	______
Overall rating	______

Evaluator's comments ______________________________

____

____

INTRODUCTION

The medical profession uses a language all its own. Success in the health profession depends on a person's abilities to use this language effectively. Fortunately, the vocabulary of health professions uses a number of root words, prefixes, and suffixes with common meanings that help to clarify the intent of these special terms. You have studied many of these terms in this module, and your instructor may have handouts and suggest other resources—such as a good medical dictionary—for you to use in learning this new vocabulary.

In Student Supplement 1, you learned that medical terms often consist of a root word and a prefix and a suffix. For example, the word *ascending* consists of the root word *scend* with the prefix *a* and the suffix *ing*. And, in Student Supplement 1 and Student Supplement 2, you were given two tables with prefixes, suffixes, and root words and their meanings.

Now, all you need are three basic rules to help you use the information in these tables and in a good medical dictionary to define the medical terms you will come across in your studies.

The three basic rules for defining medical terms are:

1. Define the suffix first—if there is one.
2. Define the prefix next—if there is one.
3. Define the root word last.

Therefore, for the word *ascending*,

- The suffix *ing* means "action."

- The prefix *a* means "up" or "out of."
- The root word *scend* means "climb."
- The word *ascending* means "making an upward climb."

In this assignment sheet, you will use these three rules, the information in the student supplements, and the information in a good medical dictionary to practice defining medical terms.

EXERCISE

ACTIVITY CHECKLIST

Put a checkmark on the blank line before each activity below as you complete it.

______ 1. Study the information in Student Supplement 1 and Student Supplement 2.

______ 2. Study the three basic rules for defining medical terms in the introduction to this assignment sheet.

______ 3. Check with your instructor for a good medical dictionary.

______ 4. Read each of the following problems, and on the blank lines provided within each problem, answer the questions presented in the problem.

______ 5. Complete the assignment and give it to your instructor for evaluation.

PROBLEM 1

a. What is the meaning of the suffix *-itis*?

Meaning ______________________________

____

b. What is the meaning of the prefix *nephr-*?

Meaning ______________________________

____

c. What type of condition is *nephritis* and what organ does it involve?

____

____

PROBLEM 2

a. What is the meaning of the prefix *anti-*?

Meaning ______________________________

____

b. What is the meaning of the root word *pyretic*?

Meaning ______________________________

c. Aspirin is said to be *antipyretic*. To what characteristic of aspirin does this refer?

PROBLEM 3

a. What is the meaning of the suffix *-osis*?

Meaning ______________________________

b. What is the meaning of the prefix *arterio-*?

Meaning ______________________________

c. What is the meaning of the root word *sclero*?

Meaning ______________________________

d. What type of condition is *arteriosclerosis* and what body components are involved?

PROBLEM 4

a. What is the meaning of the suffix *-uria*?

Meaning ______________________________

b. What is the meaning of the root word *bacter*?

Meaning ______________________________

c. Describe the condition referred to as *bacteruria*.

Description ______________________________

PROBLEM 5

a. What is the meaning of the suffix *-edema*?

Meaning ____

____

b. What is the meaning of the root word *cephal*?

Meaning ____

____

c. What is *cephaledema*?

____

____

PROBLEM 6

What term would be used to refer to a doctor who specializes in treating the *heart*? Describe on the blanks below how you used a root word and two suffixes to determine the correct definition of the term.

____

____

____

____

PROBLEM 7

What is a *colostomy*? What is the meaning of each of the two root words from which colostomy is derived?

____

____

____

____

PROBLEM 8

What term would be used to refer to the *removal of the thyroid gland*?

____

____

PROBLEM 9 What is an *angiogram*?

PROBLEM 10 What is the term for *normal breathing* and the term for *difficult breathing*? What are the root words and prefixes that help you determine these meanings?

MODULE SET I: Introduction to Anatomy and Physiology

Module 2: Biochemistry and Microbiology

Module Contents

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Information Sheet 9
Assignment Sheet
1—Practice Critical Thinking: Complete Biochemistry and Microbiology Case Studies 53

Module Set I: Introduction to Anatomy and Physiology
Module 2: Biochemistry and Microbiology

PREREQUISITES:
Module 1

Learning Activities Sheet

Student name ______________________________

DIRECTIONS

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objectives 1 through 52.

☐ 5. **Research** Online resources to learn more about biochemistry and microbiology. Your instructor will list several web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 6. **Take** Written Test provided by your instructor.

☐ 7. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, repeat steps 4 through 6.

☐ 8. **Do** Assignment Sheet 1, "Practice Critical Thinking: Complete Biochemistry and Microbiology Case Studies."

☐ 9. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 10. If the evaluation is not satisfactory, repeat step 8.

☐ 10. **Check** With your instructor for any additional assignments to be completed.

☐ 11. **Do** Additional assignments your instructor lists below.

☐ 12. **Take** Module Review provided by your instructor.

☐ 13. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 14. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheet, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

Module Objective Sheet

Unit Objective

After completing this module, you should be able to describe the role of the major elements and compounds found in the human body, discuss the factors that affect cell growth and reproduction, and describe the classes of microorganisms found in the human body. You should demonstrate these competencies by completing the assignment sheet and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

Specific Objectives

After completing this module, you should be able to

1. Define the terms *biochemistry* and *microbiology*.
2. Discuss the role of chemistry in human health.
3. Define the term *homeostasis*.
4. Define the term *element*.
5. Define the term *atom*.
6. Label the parts of an atom.
7. Define the term *molecule*.
8. Distinguish among the definitions of the terms *compound, mixture,* and *solution*.
9. Describe the primary role of each of the principal elements and compounds in the body.
10. Complete statements that describe the chemical reactions that take place in the body.
11. State the functions of the major types of organic compounds in the body.
12. Complete phrases that describe the components of the major types of organic compounds in the body.
13. Complete statements that describe the major elements and compounds that compose the body.
14. Define types of solutions.
15. Define the major types of fluid in the body.
16. Define the term *electrolyte*.
17. Discuss the role of electrolytes in human health.
18. Discuss the role of acids and bases in human health.
19. Define the term *metabolism*.

20. Complete statements that describe the use of energy by the body.
21. Complete statements that describe the characteristics of body temperature.
22. State definitions of the basic activities that define life.
23. State the cell theory.
24. State the functions of the compounds found in protoplasm.
25. Define the principal types of protoplasm.
26. Label the major parts of a cell.
27. Match the major parts of a cell to their correct functions.
28. Describe the major parts of a cell nucleus.
29. Describe the specialized structures in cells.
30. State the functions of the specialized structures in cells.
31. List the functions of a cell.
32. Define the term *transport.*
33. Distinguish between descriptions of the terms *active transport* and *passive transport.*
34. Match types of passive transport to their correct descriptions.
35. Match types of active transport to their correct descriptions.
36. Complete statements that describe the process of cell growth.
37. Describe the types of cell reproduction.
38. Describe the process in which the genetic makeup of a cell can be changed.
39. List the sources of mutation-causing conditions.
40. Match the types of cellular respiration to their correct descriptions.
41. Arrange in order the levels in the taxonomy system used to classify organisms.
42. Match the types of relationships between organisms to their correct descriptions.
43. Describe the classes of microorganisms.
44. Label the classes of microorganisms as classified by their shape.
45. Define the terms *resident flora* and *transient flora.*
46. Describe the purpose of a gram stain.
47. Complete statements that describe the characteristics of bacteria.

48. Complete statements that describe the characteristics of rickettsiae.

49. Complete statements that describe the characteristics of viruses.

50. Complete statements that describe the characteristics of protozoa.

51. Complete statements that describe the characteristics of fungi and algae.

52. Complete statements that describe common parasites that afflict humans.

53. Practice critical thinking: complete biochemistry and microbiology case studies. (Assignment Sheet 1)

Information Sheet

OBJECTIVE 1

Define the terms *biochemistry* and *microbiology.*

1. **Biochemistry**—The study of chemistry as it relates to life

✔ **NOTE:** Everything in the universe exists as either **matter** or **energy.** Another name for matter is *chemicals,* and the study of what matter is made of is called *chemistry*. The study of chemistry as it relates to life is referred to as *biological chemistry* or simply *biochemistry.* The two basic functions of chemicals in the body are to provide structure to the body and to provide a source of energy to support life.

2. **Microbiology**—The study of extremely small life

✔ **NOTE:** *Bio-* is a prefix that means *life*, and *biology* is the study of life. Another prefix is *micro-*, which means *extremely small.* Thus, *microbiology* is the study of extremely small life. In this module, you will study the chemical nature of life and will consider the smallest building blocks of life—from chemicals to the cells that those chemicals form and support.

KEY TERMS

Matter (mat´-uhr)—That portion of the universe that has shape and substance

Energy (en´-uhr-je)—The capacity to do work

✔ **NOTE:** The definition presented here is the classic scientific definition of the term *energy*. Work can be understood as a force that can bring about change in matter or other types of energy. That force may change the shape or the state of the matter, such as bending a bar or melting ice. Energy is classed as kinetic (energy in motion) or potential (stored energy). There are also several forms of energy, including light, sound, heat, mechanical, chemical, electrical, and radiation. All of these forms are involved in the functioning of the body and its care through medical practices. For example, there is stored chemical energy in the food we eat. The body converts that stored energy into heat energy, which can help the functioning of the body.

OBJECTIVE 2

Discuss the role of chemistry in human health.

1. **The body consists of various chemicals.**

✔ **NOTE:** The major chemicals of the body are oxygen (65 percent), carbon (19 percent), hydrogen (10 percent), and nitrogen (3 percent). Water, which makes up almost three-fourths of a person's body weight, consists of oxygen and hydrogen. Matter exists in three primary forms: **liquids**, **gases**, and **solids**. Chemicals are found in the body in all three forms. Bones and muscle are primarily solids. Blood and saliva are liquids. The air in the lungs and throughout the cavities in the body consists of gases.

KEY TERMS

Liquid (lik´-wuhd)—A state of matter in which the substance will take on the shape of a container but will not expand to fill a container with greater volume than the substance

Gas (gas´)—A state of matter in which the substance will take on the shape of any container in which it is placed and will expand to fill the container

Solid (sawl´-uhd)—A state of matter in which the substance has a definite shape that is maintained unless acted upon by a force that is capable of changing that shape

2. **Most body activities involve chemical reactions.**

✔ **NOTE:** The basic chemical reaction in the body is referred to as ***cell respiration***. In cell respiration, the chemical glucose, a sugar found in many foods, combines with oxygen that has been breathed into the lungs and carried to the cells by the blood system. The reaction between these two chemicals produces the chemicals carbon dioxide, water, and adenosine triphosphate (ATP), as well as heat. Carbon dioxide is carried in the bloodstream to the lungs and breathed out, while the water is used in various ways, including to help maintain the structure and chemical balance of the cells. ATP provides energy for other chemical reactions within the cell. The heat helps to warm the body and improves the efficiency of some chemical reactions.

KEY TERMS

Chemical reaction (kem´-i-kuhl re-ak´-shuhn)—A process in which one or more chemicals that are exposed to other chemicals or sources of energy such as heat change their chemical composition to produce other chemicals and often other forms of energy

Respiration (res-puh-ra´-shuhn)—The physical and chemical processes by which an organism supplies its cells and tissues with oxygen and removes carbon dioxide

3. **For a person to remain healthy, the chemicals within the body must remain properly balanced.**

✔ **NOTE:** Chemical imbalances can occur for a number of reasons related to the chemicals we take into the body or how those chemicals are processed internally. We obtain vitamins and minerals from the foods we eat. If a person's diet does not contain sufficient amounts of these vitamins and minerals, his or her health can be affected. For example, a person may not get enough iron in the diet. Iron is essential to healthy blood, and iron deficiency can lead to a condition in which the blood is not able to carry oxygen and **nutrients** effectively. On the other hand, a person who has sufficient iron intake may suffer the same condition if the iron cannot be digested and absorbed through the walls of the stomach and intestines.

KEY TERM

Nutrient (nu´-tre-uhnt)—A substance that can be processed by the digestive system and used by the cells to produce energy or build tissue

4. **The body also produces special chemicals that regulate body functions.**

   ✔ **NOTE:** The organs and glands of the body produce various chemicals used to carry out body functions. Some specialized chemicals called *hormones* have specific roles in controlling growth, reproduction, and overall health. In some instances, the body may produce too much of a chemical, such as excessive digestive-fluid production, which can lead to holes called *ulcers* in the digestive tract.

5. **Chemicals entering the body from the external environment can affect the balance of chemicals within the body and can disrupt normal physiological chemical reactions.**

   ✔ **NOTE:** Chemicals enter the body through the nose, mouth, and other openings; through breaks in the skin; and through the skin itself. In some cases, it is important to have chemicals enter the body, such as when oxygen enters the body during breathing. However, a person may also breathe in harmful chemicals. The harm that such chemicals cause is generally the result of disrupting normal functions. For example, a person may inhale carbon monoxide if sitting in a parked car while it is running. Carbon monoxide readily attaches to the red blood cells that normally carry oxygen throughout the body. If the red blood cells are loaded with carbon monoxide, they cannot accept oxygen as they pass through the lungs. If enough carbon monoxide enters the bloodstream so that there is not adequate oxygen getting to the brain and other vital organs, eventually the person affected will lose consciousness and even die if not removed from the source of the carbon monoxide. Another way in which a person can be adversely affected by chemicals occurs when organisms such as harmful viruses enter the body. These organisms may produce chemicals called *toxins* that disrupt body functions.

6. **Injuries and diseases can change the chemical balance within the body and can disrupt chemical reactions.**

   ✔ **NOTE:** Injuries and diseases can affect the body's abilities to produce chemicals internally or to process chemicals taken in from external sources. For example, diabetes is a family of conditions that affect the body's ability to convert glucose to energy and other chemicals.

OBJECTIVE 3 **Define the term *homeostasis*.**

- **Homeostasis** (ho-me-o-sta´-suhs)—The state of the body in which conditions remain relatively stable despite changes in the environment

  ✔ **NOTE:** Basically, the human body is a chemical engine. Humans place chemicals (food) in the body and subject those substances to chemicals within the body to create chemical reactions. One's health depends on providing the body with the proper amounts and types of chemicals and the body's ability to properly process those chemicals. One aspect of chemical processing within the body is responding to changes in the environment in order to maintain health. For example, the human body functions best at a temperature between approximately 97° F and 99° F (36° C and 38° C). If the temperature of the outside environment drops, the body will increase its production of energy and reduce blood circulation in the extremities to ensure adequate warmth for the vital organs. On a hot day, the body will sweat more, which removes heat from the body and increases cooling of the skin due to the evaporation of the perspiration. These and other reactions to changes in the external and internal environment of the body help to maintain homeostasis.

OBJECTIVE 4 **Define the term *element*.**

- **Element**—One of more than 100 primary, simple substances that cannot be broken down by chemical means into any other substance

OBJECTIVE 5 **Define the term *atom*.**

- **Atom**—The smallest division of an element that exhibits all the properties and characteristics of the element

✔ **NOTE:** All matter is made up of three smaller particles: neutrons, electrons, and protons (see Objective 6). The number of protons in the nucleus of an atom determines the **atomic number** of the element.

KEY TERM

Atomic (uh-tawm´-ik) **number**—The number of protons, or positive charges, in the nucleus of an atom of a particular element

OBJECTIVE 6 **Label the parts of an atom.**

✔ **NOTE:** All matter is made of particles called *atoms*. Atoms, in turn, consist of three smaller particles (see Figure 1). In the center of the atom, termed the ***nucleus***, are **protons** and **neutrons**. The third particle is called an ***electron***. Electrons go around the nucleus in orbits, with each electron following a separate path. The atoms of different materials differ in the number of each type of particle they contain. Generally, there is an equal number of electrons, protons, and neutrons in an atom. For example, a hydrogen atom contains one of each of the particles, while an oxygen atom consists of eight electrons, protons, and neutrons each. As the number of electrons increases, the additional groups of orbits that are required are found at greater distances from the nucleus. All the orbits that are at an equal distance from the nucleus are referred to as a ***shell***. Each shell is capable of supporting a specific number of electrons. The electrons in the outer shell can be shared with other atoms to form ***bonds***. Atoms that bond to each other form structures called *molecules* (see Objective 7).

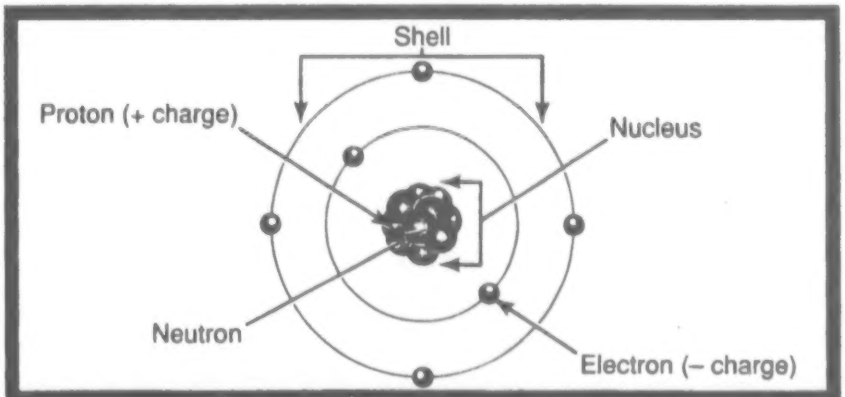

Figure 1
Parts of an atom

KEY TERMS

Nucleus (nu´-kle-uhs)—The structure in the center of an atom consisting of protons and neutrons and about which electrons orbit

✔ **NOTE:** The nucleus of each element is unique to that substance. Hydrogen is the smallest atom, with one neutron and one proton in its nucleus. Helium has two neutrons and two protons. This progression continues through the natural elements up to uranium with 92 neutrons and protons. The number of protons and neutrons is used to identify each element and is called its *atomic number*. Two of the more-common elements in the body, along with hydrogen, are carbon, with an atomic number of 6, and oxygen, with an atomic number of 8.

Proton (pro´-tawn)—A positively charged particle that is a fundamental component of the nucleus of atoms

Neutron (nu´-trawn)—An elementary particle that is a fundamental component of the nucleus of atoms; it has no electric charge

Electron (i-lek´-trawn)—A negatively charged elementary particle of an atom

Shell (shel´)—The set of electron orbits in an atom that have the same energy level

✔ **NOTE:** The innermost shell of atoms can hold up to two electrons. Thus, hydrogen and helium have one shell. The second shell or energy level consists of electrons with orbits that are farther from the nucleus than the innermost shell. The second shell can have as many as eight electrons, which means that the elements up to atomic number 10 (neon) have only two shells. Additional shells hold eight electrons or up to a multiple of eight electrons.

Bond (bawnd´)—The mechanism by which atoms link to one another to form molecules involving the loss of, gaining of, or sharing of electrons in the outer shell

✔ **NOTE:** There are three types of chemical bonds among atoms. In an *ionic bond*, an atom gives up one or more electrons to another atom. This results in the atom having more protons than electrons, giving it a positive charge. The atom that gains electrons has more electrons than protons, meaning that the atom has a negative charge. The difference in charges holds the atoms together. In what is called *covalent bonding*, an atom that does not have an outer shell that is filled to its full capacity with electrons can share electrons with one or more other atoms. Finally, hydrogen is the smallest atom with only one proton and one electron. When hydrogen shares its electron with another atom, it causes a slightly positive charge in the atom, making it particularly attractive to oxygen and nitrogen atoms, which are slightly negative. This special attraction is referred to as *hydrogen bonding*. Hydrogen bonds are especially important in the human body because hydrogen bonds help hold water molecules together, as well as many of the proteins that are essential to body structure and functioning.

OBJECTIVE 7

Define the term *molecule*.

- **Molecule**—A structure consisting of two or more atoms

  ✔ **NOTE:** A molecule may consist of atoms of the same element or atoms of two or more different elements. For example, oxygen in the air is often present as molecules of two atoms, which is written using the symbol for oxygen (O) and a subscript 2 to show that there are two atoms: O_2. Water is a compound, and its molecules consist of two hydrogen (H) atoms and one oxygen atom, represented symbolically as H_2O.

OBJECTIVE 8

Distinguish among the definitions of the terms *compound, mixture*, and *solution*.

✔ **NOTE:** When substances are put together, they form relationships that may or may not involve a chemical reaction between them. A chemical reaction (see Objective 10) results in a change in the reacting chemicals. For example, in a reaction between two compounds, the atoms may be rearranged to form one or more other compounds or they may simply break into the elements that make up the original compounds. In other instances, nothing chemical happens between substances that are mixed together. Whether a reaction takes place depends on a number of factors—most importantly, the chemicals involved and the presence or absence of **catalysts**.

KEY TERM

Catalyst (kat′-uhl-uhst)—A substance that affects the rate of change in a chemical reaction without being changed chemically

✔ **NOTE:** Generally, a catalyst will cause a reaction to begin or will cause the reaction to proceed at a faster rate. However, the catalyst itself is not affected by the reaction. As stated in the previous note, energy can have a catalytic effect, such as stirring sugar into a solution or heating the solution to increase the amount of sugar that will dissolve. Time, pressure, light, and other factors may also affect the efficiency of a chemical reaction.

1. **Compound**—A substance that consists of atoms of two or more different elements bonded together as molecules; to separate its components into other compounds and elements requires a chemical reaction

2. **Mixture**—A substance that consists of two or more combined components that do not interact chemically; to separate its components requires either a mechanical method or the application of energy

   ✔ **NOTE:** Numerous methods exist for separating mixtures, many of which are applied to medical procedures. One method of separating mixtures in which the substances are different sizes is filtration in which the mixture is forced through a material that allows smaller substances to pass through while preventing the passage of larger particles. Blood, urine, and other body fluids are sometimes filtered to remove impurities or certain components. In some cases, energy is used to separate the substances. For example, a mixture may be spun in a **centrifuge** to separate substances based on their mass (weight). An electrical charge can be used to remove negative or positive ions.

KEY TERM

Centrifuge (sen´-truh-fyuj)—A device that is used to separate the components of a solution or liquid mixture by spinning the substance

✔ **NOTE:** One of the laws of physics deals with centrifugal force. Basically, this law is a variation on the law of inertia, which states, in part, that an object in motion tends to continue in motion in a straight line unless acted upon by another force. When an object is spun in a circle, it tries to move in a straight line, but it is forced to follow a curved path. If the object is spinning fast enough, any substance that is free to move within the object will move toward the outside of the circular path. This explains why water will remain in a bucket if you swing the bucket over your head. The heavier the freely moving substance is, the quicker it will move toward the outside of the circular path. This principle can be used in medicine to separate the substances in a liquid, such as the cells in blood. A centrifuge is used to accomplish this separation.

3. **Solution**—A substance that consists of one or more components dissolved in a liquid; to separate its components, the energy of the substance must change so that the energy balance between the components prevents the liquid from being able to hold the dissolved material

   ✔ **NOTE:** Whether a substance will dissolve in a liquid depends on a number of factors. Consider placing sugar in water. If one places a teaspoon of sugar in a glass of water, some of the sugar will dissolve and some will settle to the bottom. The chemical relationship between water and sugar allows the sugar to dissolve, but at a relatively slow rate. If the solution is stirred, more of the sugar will dissolve because the stirring adds mechanical energy to the solution. Similarly, if the solution is heated, more sugar will dissolve because of the heat energy. However, if one keeps increasing the **concentration** of sugar, eventually the solution will reach its **saturation point** and no more sugar will dissolve even with additional stirring or heat.

KEY TERM

Concentration (kawn-sen-tra´-shuhn)—The ratio of the components of a solution or mixture

✔ **NOTE:** Assume that a certain medication is to be mixed with an equal amount of water before being provided to the patient, using 0.5 liter of medicine and 0.5 liter of water. The resulting solution would be half water and half medicine. It could then be referred to as a 50 percent solution of medicine (or water). Solutions are often referred to as *percentages*. Thus, a 1 percent saline solution would be 99 percent water and 1 percent salt. Generally, these percentages refer to the volume of the substances in solution though occasionally measurements are made as weight. Also, concentrations are sometimes given as ratios rather than as percentages. The 50 percent solution of medicine described earlier can also be referred to as a 1:1 ratio, meaning that for one measure of medicine there is one measure of water.

KEY TERM

Saturation point (sach-uh-ra´-shuhn point´)—The concentration level of a solution above which no more of a substance will dissolve

✔ **NOTE:** If one continues to add a *solute*—the substance being dissolved—to a liquid, at some point there will be more solute than the liquid can dissolve. This is called the *saturation point*. The saturation point can be changed through the use of catalysts, heat, stirring, and in other ways. One can also add more *solvent*—the liquid—but this does not actually change the saturation point if all other conditions remain the same. It simply lowers the concentration of solute, allowing more to be added if desired.

OBJECTIVE 9

Describe the primary role of each of the principal elements and compounds in the body.

1. **Oxygen** (awk´-si-juhn)—Required for the chemical reaction that releases energy from nutrients; one of the atoms in a water molecule; a key element in other compounds of importance to the body

   ✔ **NOTE:** The earth's atmosphere is approximately 21 percent oxygen, which we take into the body by breathing and, to a much lesser degree, through the breakdown of oxygen-containing compounds in nutrients. Oxygen is required for the release of energy within the cells. Oxygen is also an important part of water (H_2O). The body is approximately 60 to 75 percent water. Much of the rest of the body is composed of **organic compounds**, which often contain oxygen in their structure.

KEY TERM

Organic compound (or-gan´-ik kawm-paund´)—A compound that contains carbon and hydrogen

✔ **NOTE:** Life on earth is referred to as being *carbon-based* because the physical structures of all organisms are made principally of compounds that contain carbon and hydrogen. Compounds that do not contain carbon and hydrogen, such as water, are referred to as *inorganic compounds*.

2. **Carbon dioxide** (kar´-buhn di-awk´-sid)—Given off as a waste product of cell respiration

   ✔ **NOTE:** Carbon dioxide is a compound consisting of molecules with one carbon atom and two oxygen atoms (CO_2). When nutrients are converted to energy, excess atoms of carbon and oxygen combine to form carbon dioxide. Carbon dioxide is carried to the lungs, from which it is returned to the atmosphere through **exhalation**. If the body is unable to remove CO_2 at a sufficient rate so that the gas builds up in the body, acids form and may lead to a condition called *acidosis*, which can interfere with normal functioning of the body. Diseases such as pneumonia may impair normal elimination of carbon dioxide.

KEY TERM

Exhalation (eks-huh-la´-shuhn)—The act of breathing out or exhaling

✔ NOTE: Breathing consists of two steps. Taking air into the lungs is called *inhalation* or *inspiration*. Breathing out is called *exhalation* or *expiration*.

3. **Water** (wawt´-uhr)—Dissolves substances to make them more usable to the body; provides fluid to **lubricate** moving parts of the body; helps to maintain body temperature

   ✔ NOTE: The process of moving nutrients and chemicals through the body is highly dependent on water because most of these substances must be dissolved in order to pass through the body and into cells. Water is an effective solvent and dissolves directly or indirectly (as the liquid part of blood, for example) most of the chemicals that must be transported through the body. The process actually begins with saliva in the mouth. This water begins dissolving nutrients. It also lubricates the food to make it easier to chew and to swallow. In the digestive tract, water helps to carry nutrient chemicals through membranes and to the cells. Finally, water heats and cools slowly. Because most of the volume of the body is saturated with water, body temperature does not change quickly with changes in environmental temperature, helping to maintain homeostasis.

KEY TERM

Lubricate (lu´-bruh-kat)—To improve the ease of movement between two objects by applying a substance that reduces friction

✔ NOTE: Friction is the resistance to movement of objects that are in contact with each other. For example, if you press your hands against each other and try to move them, it takes some effort. If you cover your hands with soap and water and rub them against each other it takes less effort because the soap and water have reduced the friction. You may also notice that when you rub your dry hands together, they get warm. This is a result of friction. While you cannot see it, you also rub cells and parts of dead tissue off your hands. Inside the body, where structures rub against each other, such as at the joints between bones, there is friction. Water and fluids largely composed of water in the body help reduce that friction, which allows the body structures to last longer.

4. **Glucose** (glu´-kos)—Serves as the primary energy source for the cells

   ✔ NOTE: Glucose is a complex compound that consists of 6 carbon atoms, 12 hydrogen atoms, and 6 oxygen atoms ($C_6H_{12}O_6$). It belongs to a class of chemicals called *monosaccharides* (mawn-uh-sak´-uh-rids) or *simple sugars*. Glucose may be taken into the body in nutrients, or it may be produced by the liver from other sugars.

OBJECTIVE 10 **Complete statements that describe the chemical reactions that take place in the body.**

1. **A chemical reaction involves an interaction between two or more chemicals that results in matter with a different chemical composition from the chemicals that were originally introduced into the reaction.**

   ✔ **NOTE:** Chemists record chemical reactions with symbols similar to math equations. For example, the basic reaction in the cells that converts glucose into energy can be written:

   $$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{heat}$$

   This formula shows that when a molecule of glucose ($C_6H_{12}O_6$) is combined with 6 molecules of oxygen (O_2) it is converted into (→) 6 molecules of carbon dioxide (CO_2), 6 molecules of water (H_2O), and heat. The glucose comes from digested food, while the oxygen is taken into the lungs during respiration. Both glucose and oxygen are delivered to the cells by the circulatory system. The carbon dioxide is returned to the bloodstream and breathed out from the lungs. The water is used to maintain the health of the cells and to transport substances in and out of the cells, while the heat produced is the energy that allows the cells to do work. Note that there are 6 carbon atoms, 12 hydrogen, and 18 oxygen atoms on each side of the equation.

2. **A reaction that causes atoms or molecules to bond, thus producing different chemicals, is called a *synthesis reaction.***

   ✔ **NOTE:** An example of a synthesis reaction would be the formation of water:

   $$2H_2 + O_2 \rightarrow 2H_2O$$

   In this formula, free hydrogen and free oxygen molecules bind through hydrogen bonds to form or *synthesize* water.

3. **A reaction that causes molecule bonds to break is called a *decomposition reaction.***

   ✔ **NOTE:** The conversion of glucose and oxygen into carbon dioxide, water, and heat is a decomposition reaction. While it is true that new compounds are formed, the reaction begins by decomposing existing molecules by breaking their bonds.

4. **Synthesis reactions are necessary to allow the body to build proteins and other building blocks of cells and tissue.**

5. **Decomposition reactions are necessary to allow the body to break down the large, complex molecules of nutrients into small, easily transported molecules that the cells can use to sustain life.**

   ✔ **NOTE:** While it is true that there are proteins in the foods we eat, most of them are not directly usable by the body. Most proteins are broken into their carbon, hydrogen, oxygen, and nitrogen components so that the body can build the proteins that it needs, such as hemoglobin and collagen.

6. **Catalysts or energy can be added to a chemical reaction to increase the rate of reaction.**

✔ **NOTE:** Enzymes are perhaps the most-important catalysts in the body because they are responsible for assisting in thousands of kinds of reactions. According to the active site **theory**, enzymes perform their catalytic function because of their shapes. Each enzyme has receptor sites on the outer surfaces. The chemical that a particular enzyme catalyzes has a shape that exactly fits the enzyme's receptor site, much like the pieces of a jigsaw puzzle fit together. Each enzyme receptor site exactly matches one chemical molecule, referred to as a *substrate*. For example, the digestive enzyme involved in the breakdown of the muscle protein of ingested meat will not catalyze the starch in potatoes. Generally, the enzyme can be envisioned to attach to a chemical and pull it away from a molecule. Another receptor site then attaches to a second chemical and pulls it from its molecule. The chemicals in the receptor sites then form bonds with each other and release from the enzyme. Thus, a new substance is produced and the enzyme is left unchanged.

KEY TERM

Theory (the´-uh-re)—A statement that provides an explanation based on evidence without final proof being obtained

✔ **NOTE:** Like the active site theory, there are many ideas about how the body functions that cannot be proved. Many of these will probably be proved or disproved as science continues to make advances, such as new methods for examining processes inside the body. The explanations offered by theories are not guesses. Theories are based on known facts and attempt to take those facts into consideration in their explanations.

7. **The failure to provide the reactive chemicals in the proper proportions, the introduction of additional chemicals, or the failure to provide a required catalyst or energy source can prevent the reaction from happening.**

✔ **NOTE:** A poor diet can lead to not having the proper chemicals in the body, and disease may interfere with normal chemical reactions. For example, with certain illnesses, the body may develop acidosis, or an excess of acid, and the accompanying positive hydrogen ions (H+). In some instances, these hydrogen ions may attach to enzyme receptor sites that would normally break down carbohydrates and other chemicals or the ions may change the shape of the enzyme, making it impossible for the enzyme to perform its function. The **fever** that accompanies some illnesses may increase the temperature to a point that the internal bonds of the enzyme break down and are unable to perform their function. Enzymes that have changed shapes are said to be *denatured*.

KEY TERM

Fever (fe´-vuhr)—An abnormally high body temperature

✔ **NOTE:** Fever often accompanies a number of diseases. Body temperature is discussed in more detail in Objective 21.

OBJECTIVE 11

State the functions of the major types of organic compounds in the body.

1. **Carbohydrates** (kar-bo-hi´-drats)—Serve as the major source of energy
2. **Lipids** (lip´-uhds)—Serve as a means of storing energy, providing structure to cell membranes, and influencing some hormone functions
3. **Proteins** (pro´-tens)—Serve many roles in the human body that can be generally classed as *functional*, in which the protein regulates a chemical reaction, or *structural*, in which the protein is a component in cells and tissues

   ✔ **NOTE:** All proteins are large molecules called *macromolecules* and are the most-abundant organic chemical in the body.

4. **Nucleic** (nu-kle´-ik) **acids**—Serve to encode and decode information required for the production of structural protein

   ✔ **NOTE:** The nucleic acids provide a coded plan for how an individual organism is supposed to be assembled. This coded plan is referred to as the ***genetic code***.

KEY TERM

Genetic code (juh-net´-ik kod´)—The sequence of bases in DNA that determines how the organism will be structured

✔ **NOTE:** The segments of DNA called *genes* each have a specific purpose in determining the characteristics of the organism. Some traits are common to a given type of organism. For example, genes for the number of fingers and toes, eyes, and ears, and their locations are pretty much the same from person to person. However, the gene sequence that determines the color of the eyes and the shape of the ears will vary from person to person. Genetic code is especially important to health professionals because the code helps to determine whether a particular person is likely to become afflicted with certain illnesses or conditions. For example, a person may be more likely to have high blood pressure, liver cancer, or a heart condition because of that person's genetic code.

OBJECTIVE 12

Complete phrases that describe the components of the major types of organic compounds in the body.

1. **Carbohydrates**

   - Consist primarily of sugars or saccharides (sak´-uh-rids)
   - Include monosaccharides (mawn-uh-sak´-uh-rids), which are simple sugars that provide nutrient energy and form other compounds

     ✔ **NOTE:** Simple sugars contain five carbon atoms and are called *pentose* or contain six carbon atoms and are referred to as *hexose*. There are three principal hexose saccharides that are important to the body: glucose (glu´-kos), fructose (fruhk´-tos), and galactose (guh-lak´-tos). Glucose is the major source of energy. The liver can convert fructose and galactose into glucose when extra energy is needed.

- Include ribose (ri´-bos) and deoxyribose (de-awk´-si-ri-bos), which are part of the nucleic acids that form the genetic code in cells

✔ **NOTE:** The two most-important pentose monosaccharides are ribose and deoxyribose. Their primary importance is in the formation of nucleic acids—proteins that carry the chemical "blueprint" of how the body is to be formed and the code for traits such as hair color, handedness, eye color, etc.

- Include oligosaccharides (awl-i-go-sak´-uh-rids), which serve as antigens on the outer surface of cell membranes

✔ **NOTE:** There are other sugars that are more complex than monosaccharides. Disaccharides are two monosaccharides joined by covalent bonds. Sucrose, common table sugar, is a disaccharide consisting of glucose and fructose. Oligosaccharides, or *few sugars*, are chains of 3 to 20 monosaccharides.

- Include cellulose (sel´-yuh-los), an indigestible substance that provides bulk to the contents of the digestive tract and promotes healthy movement through the intestines

✔ **NOTE:** Polysaccharides, or *many sugars*, may consist of several thousand monosaccharide molecules. Cellulose is a nearly straight polysaccharide found in the cell walls of plants. Other polysaccharides include glycogen (gli´-kuh-juhn) and starches, which are described below.

- Include glycogen, which consists of a very-complex chain of glucose molecules that can be stored in the liver and skeletal muscles until converted back into glucose
- Include starches, which consist of chains of glucose that are split apart during digestion

2. **Lipids**

- Consist of carbon, hydrogen, and sometimes phosphorus (faws´-fruhs), often in the form of fatty acids
- Include triglycerides (tri-glis´-uh-rids), which store energy primarily in the form of body fat

✔ **NOTE:** True fats consist of a molecule of glycerol and one, two, or three molecules of fatty acids. Triglycerides have three fatty-acid molecules. These lipids are stored between the skin and muscles and around certain organs. When the intake of nutrients does not supply enough energy, the fat can be converted into glucose and used to produce energy.

- Include phospholipids (faws-fo-lip´-uhds), which are one constituent of cell membranes

✔ **NOTE:** Lipids with two fatty acids and a phosphate group (a phosphorus atom with four atoms of oxygen, PO_4) are referred to as *phospholipids.* They help to form walls and sheaths around cells in various structural configurations of molecules.

- Include steroids (stir´-oids), which are one constituent of cell membranes and assist with hormone synthesis

  ✔ **NOTE:** Steroids differ in structure from other lipids in that they do not consist of glycerol and fatty acids. Instead, they contain four rings of carbon with hydrogen and other molecules attached. Steroids include cholesterol (kuh-les´-tuh-rol) and certain hormones.

- Include prostaglandins (praws-tuh-glan´-duhns), which regulate hormone action, enhance the immune system, and affect the **inflammatory response**

  ✔ **NOTE:** There are several types of prostaglandins, each of which is a structural variation of a 20-carbon fatty acid with a 5-carbon ring. Prostaglandins originate in virtually every type of tissue. They perform a specific purpose—usually causing a certain chemical reaction, such as aiding in the clotting of blood, increasing the body's response to disease, influencing blood pressure, and various other roles.

KEY TERM

Inflammatory response (in-flam´-uh-tor-e ri-spawns´)—The way the body reacts to an injury

✔ **NOTE:** The inflammatory response may include redness, swelling, and heat due to increased blood flow and pain due to the chemicals released by injured and dying cells. The response is ordered and normal.

3. Proteins

- Consist of amino (uh-me´-no) acids, which are made of carbon, hydrogen, oxygen, nitrogen, and in some cases, sulfur

  ✔ **NOTE:** Amino acids are chemical structures that include an amine group (NH_2) and a carboxyl group (COOH). There are 20 different amino acids. Amino acids bind to each other through what is called *peptide bonds*. Short chains of amino acids are referred to as *polypeptides* (pawl-i-pep´-tids).

- Include keratin, collagen, hemoglobin, myosin, and other structural proteins that form receptor sites in cell membranes

  ✔ **NOTE:** One of the more-important structural functions of proteins is to create receptor sites and **pores** in the cell walls. The receptor sites allow certain molecules and other chemical structures to attach to the cell wall. For example, red blood cells have receptor sites for oxygen in the hemoglobin (he´-muh-glo-buhn) protein in their walls. Keratin (ker´-uht-uhn) is found in the skin and hair, while collagen (kawl´-uh-juhn) is part of the tendons and ligaments. Myosin (mi´-uh-suhn) is found in muscles and aid in the contraction or drawing up of working muscles.

KEY TERM

Pore (por´)—An opening in a surface that allows materials to pass through

✔ **NOTE:** Pores are found in the skin, in organs, and in the cells themselves to allow the flow of materials that support life. For example, pores in the skin allow the release of perspiration, body oils, and other secretions that help to maintain homeostasis and health. Pores at the cellular level allow nutrients to penetrate the cell and allow the elimination of wastes.

- Include hormones, which regulate body functions including growth, **sexual maturation**, and cell functions

KEY TERM

Sexual maturation (sek´-shuhl mach-uh-ra´-shuhn)—The process of developing secondary sexual characteristics and becoming able to reproduce

- Include **antibodies**, which tag harmful substances in the body so that they will be destroyed
- Include **enzymes**, which serve as catalysts in chemical reactions

KEY TERMS

Antibody (ant´-i-bawd-e)—A protein molecule that will bind to foreign substances in the body

✔ **NOTE:** Antibodies are part of the immune system that protects the body against invasion by foreign organisms. Every cell—those in the body and those that may enter the body from outside—have markers, proteins called *antigens* in their cell walls. The body recognizes the antigens of its own cells, but when a foreign antigen is encountered, the body produces antibodies that can attach to the foreign antigen. The antibodies are produced by plasma cells in the blood. The receptor sites on the antibody are specific to the foreign antigen.

Enzyme (en´-zim)—A protein that acts as a catalyst in a chemical reaction

✔ **NOTE:** Enzymes are sometimes referred to as *organic catalysts*. Enzymes are located throughout the body. For example, the saliva, gastric juices, and secretions of the intestine contain enzymes to help digest food.

4. Nucleic acids

- Consist of nucleotides, which are made of a pentose sugar, a phosphate group, and one of five base chemicals that include nitrogen

  ✔ **NOTE:** The base chemicals included in nucleotides (nu´-kle-uh-tids) are adenine (ad´-uhn-en), cytosine (sit´-uh-sen), guanine (gwawn´-en), thymine (thi´-men), and uracil (yur´-uh-sil). The pentose sugars are either ribose or deoxyribose.

- Include deoxyribonucleic (de-awk´-si-ri-bo-nu-kle-ik) acid, which is a double strand of nucleotides with a structure that defines the code of inherited traits

  ✔ **NOTE:** Deoxyribonucleic acid (DNA) consists of two strands of nucleotides that are twisted in a double helix, somewhat like a ladder that has been rotated while one end was held in place. The strands of nucleotides are alternating molecules of phosphate and deoxyribose sugar. The "rungs" of the ladder are pairs of the base chemicals adenine, thymine, cytosine, and quanine. Adenine is always paired with thymine and cytozine is always paired with quanine. The sequence of the base pairs in a strand of DNA is what creates the coded information for assembling the organism. The sequence of code for one protein is called a *gene*.

- Include ribonucleic (ri-bo-nu-kle´-ik) acid, which is a single strand of nucleotides that synthesizes protein

  ✔ **NOTE:** Ribose combines with a phosphate group and four bases (adenine, cytosine, guanine, and uracil) to form ribonucleic acid (RNA). The nucleotides are joined in a single strand. RNA is formed from DNA in the cells. There are two functional types of RNA. Messenger RNA (mRNA) is a copy of the genetic code from the DNA, while transfer RNA (tRNA) builds proteins by aligning the amino acids correctly.

OBJECTIVE 13

Complete statements that describe the major elements and compounds that compose the body.

1. **More than 20 elements are found in the human body.**

2. **Oxygen is the most-common element in the body by total weight, at approximately 65 percent.**

   ✔ **NOTE:** Because oxygen is a major part of water molecules and 60 to 75 percent of body weight is water, plus the fact that many other compounds contain oxygen, this element is the most common.

3. **Carbon, at nearly 19 percent, and hydrogen, at nearly 10 percent, are the other large constituents.**

   ✔ **NOTE:** Carbon and hydrogen are large constituents of the body's composition because they are found in carbohydrates.

4. **There are also minor quantities of nitrogen, calcium, and phosphorus.**

✔ **NOTE:** Elements such as sodium, magnesium, sulfur, chlorine, and potassium make up less than 1 percent each.

5. **There are trace amounts—less than 0.1 percent—of a number of minerals, including manganese, iron, cobalt, copper, zinc, and others, as well as iodine and chlorine.**

OBJECTIVE 14 **Define types of solutions.**

1. **Isotonic** (i-suh-tawn´-ik)—A solution that has the same concentration of dissolved particles as the solution to which it is compared

   ✔ **NOTE:** The prefix *iso-* means "the same." Isotonic solutions are sometimes referred to as *normal solutions* because they are in a state of balance with the compared solution. A fundamental law of physics is that if two solutions are placed in a relationship in which they can exchange material with each other, they will tend to end up with the same concentrations of dissolved materials. The two solutions would be isotonic with each other. This is the condition of blood cells and plasma with regard to the dissolved substances in both. The concentration of dissolved minerals inside the cells is normally the same as that in the plasma, thus there is no flow between the internal and external solutions (see Figure 2 below).

2. **Hypertonic** (hi-puhr-tawn´-ik)—A solution that has a higher concentration of dissolved particles than the solution to which it is compared

   ✔ **NOTE:** If there is a difference in the concentrations of two solutions that have a relationship in which they can exchange material with each other, the solvent will flow toward the higher concentration of solute so that the concentration is reduced in the hypertonic solution. Therefore, if the concentration of the solution surrounding the cells is greater than that of the cells, material will flow from the surrounding solution to the cells (see Figure 3 below).

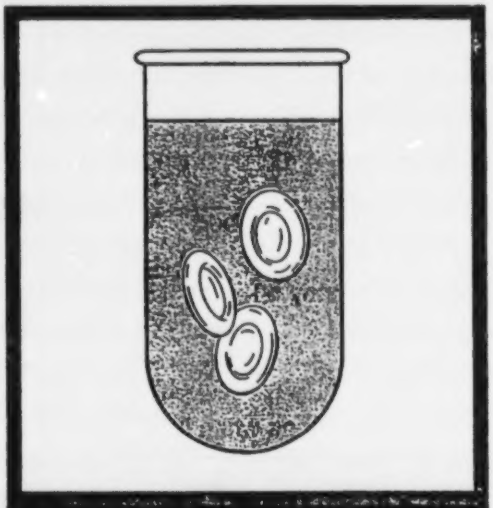

Figure 2
Types of solutions: Isotonic

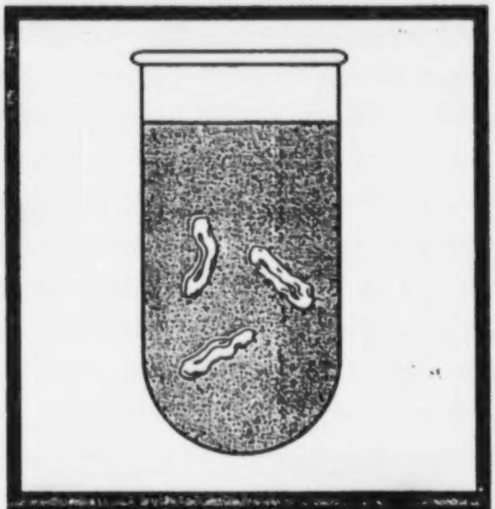

Figure 3
Types of solutions: Hypertonic

3. **Hypotonic** (hi-po-tawn´-ik)—A solution that has a lower concentration of dissolved particles than the solution to which it is compared

✔ **NOTE:** If there is a difference in the concentrations of two solutions that have a relationship in which they can exchange material with each other, the solvent will flow toward the higher concentration of solute so that the concentration is increased in the hypotonic solution. Therefore, if the concentration in the cells is greater than that in the surrounding solution, the material in the cells ruptures the cells to create an equilibrium in the surrounding solution (see Figure 4 below).

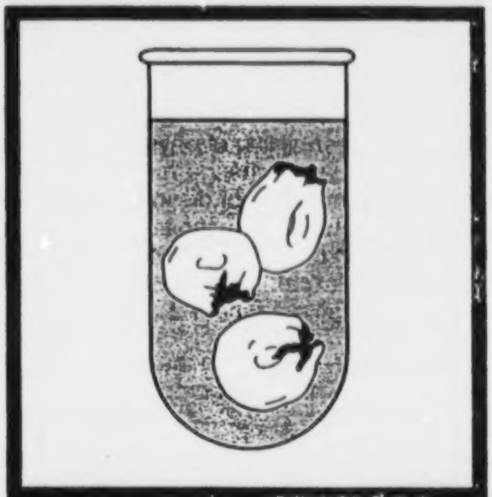

Figure 4
Types of solutions: Hypotonic

Objective 15 **Define the major types of fluids in the body.**

1. **Intracellular fluid** (in-truh-sel´-yuh-luhr flu´-uhd)—Fluid contained within the cells
2. **Interstitial** (int-uhr-stish´-uhl) **fluid**—Fluid between the cells and in special cavities, such as in the cranium
3. **Plasma** (plaz´-muh)—The fluid portion of blood

✔ **NOTE:** Plasma composes nearly 60 percent of the volume of blood.

Objective 16 **Define the term *electrolyte*.**

- **Electrolyte**—A substance that forms **ions** when it dissolves

✔ **NOTE:** Electrolytes include **salts**, **acids**, and **bases** found throughout the body. The fact that the ions have a positive or negative charge provides the body with a mechanism for moving these substances from one place to another, as ions with similar charges tend to move away from each other while those with different charges tend to move toward each other.

KEY TERMS

Ion (i´-awn)—An atom or group of atoms with either a positive or a negative electrical charge

✔ **NOTE:** An atom that has fewer electrons than protons has a positive charge and is called a *positive ion* or *cation* (kat´-i-uhn). An atom that has more electrons than protons has a negative charge and is called a *negative ion* or *anion* (an´-i-uhn). The charge of an ion can play an important role in the transport of chemicals throughout the body.

Salt (sawlt´)—A class of chemicals that have a positive ion other than hydrogen and a negative ion that is not a **hydroxyl**

✔ **NOTE:** Table salt is sodium chloride and consists of a sodium cation and an anion of chlorine. Numerous other salts exist, many of which play a role in body functioning.

Hydroxyl (hi-drawk´-suhl)—An anion consisting of one hydrogen atom and one oxygen atom

✔ **NOTE:** Hydroxyls can be considered to be the most-basic compound, while a hydrogen cation is the most-acidic. Note that combining the hydrogen cation (H^+) with a hydroxyl anion or *hydroxide ion* (OH^-) forms water (H_2O). In fact, in the body, many chemical reactions involving water are reversible breakdowns of water into H^+ and OH^- and conversion back again into water.

Acid (as´-uhd)—A substance that releases a hydrogen ion when dissolved

Base (bas´)—A substance that releases a hydroxide ion when dissolved

✔ **NOTE:** Base substances are also referred to as *alkaline* (al´-kuh-luhn).

OBJECTIVE 17

Discuss the role of electrolytes in human health.

1. **Dissolved electrolytes have an excess or shortage of electrons, giving them a negative or a positive charge respectively.**

   ✔ **NOTE:** Some of the more-common positive electrolytes in the body are sodium (Na^+), potassium (K^+), manganese (Mg^{+2}), and calcium (Ca^{+2}). The most-common negative electrolytes are chloride (Cl^-), phosphate (HPO_4^{-2}), protein anions, and sulfate (SO_4^{-2}). These substances are present in plasma and tissue fluids, though their normal concentration varies from fluid to fluid.

2. **Body functions are most efficient when the concentrations of the electrolytes are within specific ranges.**

   ✔ **NOTE:** Tissue fluid and plasma normally have high concentrations of sodium and chloride and low concentrations of potassium, manganese, and phosphate and protein ions with low concentrations of sodium and chloride. These concentration levels are vital to the functions that are performed by tissues and organs.

3. **Electrolytes are lost through sweating and through the elimination of urine and feces.**

OBJECTIVE 18 **Discuss the role of acids and bases in human health.**

1. **Acids and bases are classed as strong, using a value called *pH*, with the most-acidic substances having a value toward 0 and the most-basic substances having a value toward 14.**

   ✔ **NOTE:** The pH scale represents the potential hydrogen that a substance can accommodate. Thus, the 0 end of the scale shows that a hydrogen ion shows no reaction with another hydrogen ion, while a hydroxide ion at the 14 end of the scale will easily react with a hydrogen ion to form water. At the midpoint of the scale is pure water with a value of 7, showing that it is neither acidic or alkaline.

2. **Body fluids have a normal pH value with a narrow range above and below that value.**

   ✔ **NOTE:** The normal pH of blood is 7.35 to 7.45, meaning that it is slightly alkaline. Intracellular fluid has a pH of approximately 6.8 or slightly more-acidic than pure water.

3. **If the pH value of a fluid goes above or below its ideal range, chemical reactions will be affected.**

4. **Normal human activities can lead to major shifts in pH.**

   ✔ **NOTE:** Changes in diet, changes in exercise, environmental exposures, and illness can affect the pH balance in the body. However, normal cell respiration would also lead to an increase in acidity if the body did not have mechanisms to compensate for such changes.

5. **To compensate for these potential changes in pH, the body contains buffer systems.**

   ✔ **NOTE:** There are three major buffer systems: the bicarbonate system associated with respiration, the phosphate system associated with the kidneys, and the protein system associated with intracellular fluid.

6. **Buffer systems contain a weak acid and a weak base that react with strong acids and strong bases to produce substances that do not change the normal pH excessively.**

OBJECTIVE 19 **Define the term *metabolism*.**

- **Metabolism**—The processes that lead to chemical reactions in the body

✔ **NOTE:** Chemical reactions take place because of the natural interactions of specific substances, due to the addition of energy such as heat, or because of the presence of catalysts. A chemical reaction may either break chemicals down into other substances and energy or bond substances together. Metabolism can result either in

catabolism or **anabolism**. Both types of reactions are required for good health. For example, anabolism can lead to the formation of muscle and bone. Catabolism can result in the release of energy from nutrients.

KEY TERMS

Catabolism (kuh-tab´-uh-liz-uhm)—The process of reducing large molecules into smaller molecules

✔ **NOTE:** Anabolism requires energy to create the bonds and generally a catalyst such as an enzyme. Catabolism generally releases engery but also requires catalysts. Together, the two processes make up metabolism.

Anabolism (uh-nab´-uh-liz-uhm)—The process of chemical synthesis in which smaller molecules are combined to produce larger molecules

OBJECTIVE 20

Complete statements that describe the use of energy by the body.

✔ **NOTE:** One of the laws of physics is that energy and matter cannot be created or destroyed. They can only be converted between different forms. This is a key concept in understanding metabolism. Matter is converted into other types of matter and into energy. The energy is converted into matter—cells and other components of the body—and into other types of energy, such as the contraction of muscles so that a person can move.

1. **The primary source of energy in the body is adenosine triphosphate** (uh-den´-uh-sen tri´-faws-fat) **(ATP).**

   ✔ **NOTE:** ATP is composed of ribose, adenine, and three phosphate molecules. Adenine (ad´-un-en) is a molecule with five nitrogen and three hydrogen atoms. A molecule with the same structure as ATP except with one less phosphate group occurs naturally in cells and is called *adenosine diphosphate* (uh-den´-uh-sen di´-faws-fat) (ADP).

2. **During cell metabolism in which glucose and oxygen are converted into carbon dioxide and water, some of the energy released creates a bond between ADP and a phosphate group to produce ATP.**

3. **Energy is stored in the phosphate bonds of ATP until it is needed for cell functions.**

4. **All cells contain enzymes that allow them to break the phosphate bonds in ATP.**

   ✔ **NOTE:** The phosphate bonds are known as *high-energy bonds*. When they are broken, a relatively large amount of energy is released in the cell.

5. **Energy released from ATP fuels cell functions, including cell division to produce new cells.**

6. **Some of the energy is applied to moving substances in and out of the cell and in carrying out chemical reactions, as well as providing the cell with a stable temperature.**

OBJECTIVE 21

Complete statements that describe the characteristics of body temperature.

1. **Normal body temperature ranges from 96.5° F to 99.5° F (36° C to 38° C).**

   ✔ **NOTE:** Body temperature normally varies 1 to 2 degrees during a 24-hour period.

2. **Normal temperature is considered to be 98.6° F (37° C).**

   ✔ **NOTE:** Body-temperature regulation in infants is not as precise due to their small amount of skin-surface area. Body-temperature regulation in older adults is not as precise due to reduced efficiency in the mechanisms that regulate body temperature.

3. **Temperature is normally lower during sleep.**

4. **Body temperature is regulated by the hypothalamus.**

5. **Blood vessels near the surface of the skin constrict to reduce heat loss.**

6. **Blood vessels near the surface of the skin dilate to increase heat loss.**

   ✔ **NOTE:** Although most heat loss occurs through the skin, heat loss also occurs through exhaling breath (respiration). There is also a slight amount of heat loss through the elimination of body wastes through urination and defecation.

7. **Heat is removed from the body by sweating.**

8. **Fever is an abnormally high body temperature.**

   ✔ **NOTE:** Fever is generally the result of a disruption of the body-temperature regulation mechanisms due to injury or illness.

9. **Hypothermia is an abnormally low body temperature.**

   ✔ **NOTE:** Hypothermia is generally the result of exposure to low environmental temperatures such as exposure to cold air or water.

OBJECTIVE 22

State definitions of the basic activities that define life.

✔ **NOTE:** You have seen that our bodies consist of various assemblies of common chemicals and that most of what happens within our bodies are simply reactions among those chemicals. So what distinguishes us from other groups of chemicals, such as rocks? Scientists generally define life by the activities that are common in living organisms and are not normally found in nonliving things.

1. **Reproduction** (re-pruh-duhk´-shuhn)—The process by which organisms create more of their own kind

   ✔ **NOTE:** Living organisms must have a way of renewing themselves because all living things break down or fall victim to injury so that they eventually die. Through reproduction, a cell can divide to make a replacement or a man and a woman can have children. Reproduction may be **sexual** or **asexual**.

KEY TERMS

Sexual (sek´-shuhl)—Relating to reproduction that requires a union of two organisms or the union of separate cells

Asexual (a-sek´-shuhl)—Relating to reproduction that does not involve the union of individual organisms or separate cells

✔ **NOTE:** Asexual reproduction occurs in the simplest life forms, such as one-celled organisms, and at the cellular level in higher life forms when internal cells divide to reproduce.

2. **Growth** (groth´)—The orderly increase in size that an organism exhibits as it matures

   ✔ **NOTE:** Living things tend to get bigger as they age to the point of maturity. Even single-celled organisms double in size from a divided cell or grow from a spore or cyst.

3. **Metabolism** (muh-tab´-uh-liz-uhm)—The process by which organisms convert matter and energy to sustain life functions

   ✔ **NOTE:** It takes energy to sustain life. Organisms find this energy in nutritional matter or in the environment. For example, humans eat food and convert the food to energy and chemicals required to support the functions of life. Many plants are able to use the energy of sunlight to sustain life. Metabolism includes those internal processes that allow an organism to derive energy and the chemicals required to support life functions from external sources.

4. **Movement** (muv´-muhnt)—The ability to change the location of matter from one place to another

   ✔ **NOTE:** While it is fairly obvious that human beings and most animals travel from place to place, it may be less apparent that a tree exhibits movement or that a barnacle attached to a rock moves. Many plants turn their flowers or leaves toward the sun. Even in plants where such movement is absent, there is a flow of nutrients and water through the plant, just as blood flows through the human body. Thus, movement may be either external or internal.

5. **Responsiveness** (ri-spawn´-siv-nes)—The characteristic of an organism to react to changes in its environment

   ✔ **NOTE:** Even simple organisms are equipped with sense organs that provide the organism with an awareness of its environment. Often these environmental conditions will cause a reaction in the organism, as when you pull your hand away from a hot object. The response may be done either consciously, such as eating to relieve hunger, or automatically, such as the constriction of the pupil of the eye when exposed to bright light.

6. **Adaptation** (ad-ap-ta´-shuhn)—The process of modifying life processes to improve an organism's chances of survival

✔ **NOTE:** Adaptation may appear to be very similar to responsiveness, and the two are related. However, responsiveness generally refers to changes in the organism's behavior that cope immediately with a change in the environment, where adaptation often indicates a long-term change. Adaptation may occur for an individual, as when a snowshoe rabbit turns white in the winter, or for a species, as suggested by the **theory of evolution**.

KEY TERM

Theory of evolution (ev-uh-lu´-shuhn)—A theory that proposes that all life began as simple organic compounds that over time developed the characteristics of life and continued to become more complex in functioning and in coping with the environment

OBJECTIVE 23

State the cell theory.

■ **All organisms are made of small, enclosed bodies called *cells* and of the products of those cells.**

✔ **NOTE:** Cells are small bits of organized **protoplasm** encased in a thickened membrane. In multicellular organisms, cells tend to have a specialized function that contributes to the overall functioning of the organism.

KEY TERM

Protoplasm (prot´-uh-plaz-uhm)—The complex mass of proteins and other organic and inorganic materials that is capable of exhibiting the characteristics of life

OBJECTIVE 24

State the functions of the compounds found in protoplasm.

1. **Water**—Serves as the solvent in all cell chemistry

   ✔ **NOTE:** Water not only makes up most of the body, but it is also involved in virtually every chemical reaction that takes place in the body. About 65 percent of the water in the body is contained within cells. However, the water within the body is in constant motion, transporting molecules in and out of the cells and moving substances about the body through the bloodstream and lymphatic vessels. The transported chemicals are generally in solution.

2. **Protein**—Forms the structural framework of protoplasm
3. **Carbohydrates**—Serve as a source of energy during metabolism
4. **Fats**—Store excess energy

   ✔ **NOTE:** The energy provided by nutrients that is not required by the body immediately is converted to fat and stored between the skin and muscles.

5. **Nucleic acids**—Control the growth and reproduction of cells

6. **Mineral salts**—Serve as chemical buffers to maintain the chemical balance in cells

✔ **NOTE:** Salts serve as a source of trace elements and are needed in the cells in small quantities. For example, the formation of ATP requires that phosphate molecules be available in the cell. One source of phosphates is the mineral salt calcium phosphate.

OBJECTIVE 25 **Define the principal types of protoplasm.**

1. **Nucleoplasm** (nu´-kle-uh-plaz-uhm)—The protoplasm found in the nucleus of a cell

   ✔ **NOTE:** All human cells except mature red blood cells have a nucleus.

2. **Cytoplasm** (sit´-uh-plaz-uhm)—The protoplasm found outside the nucleus of a cell

OBJECTIVE 26 **Label the major parts of a cell** (see Figure 5 below).

✔ **NOTE:** Cells contain specialized structures that perform specific functions in maintaining the cell as a living body. The exact structures and their arrangements will vary from cell to cell depending on the type of parent organism, the cell's role within the parent organism, and the cell's stage of life. The cell shown in Figure 5 is representative of cells in general and is not intended to be a specific cell or to reflect the structure of all cells.

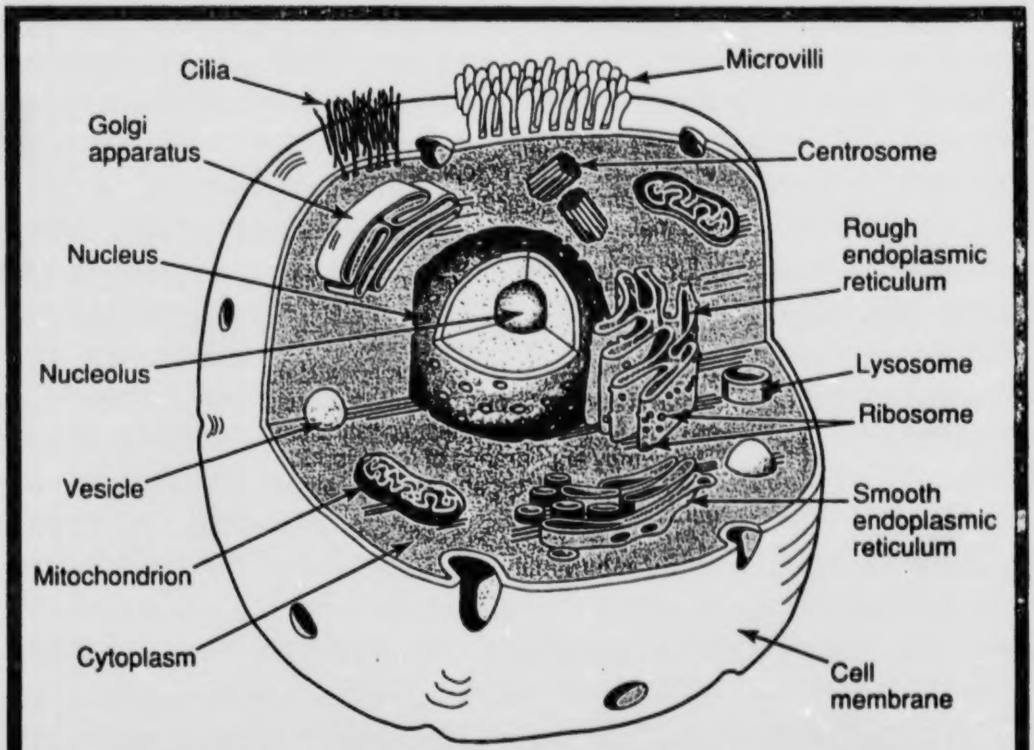
Cilia
Microvilli
Golgi apparatus
Centrosome
Rough endoplasmic reticulum
Nucleus
Nucleolus
Lysosome
Ribosome
Vesicle
Smooth endoplasmic reticulum
Mitochondrion
Cytoplasm
Cell membrane

Figure 5
Major parts of a cell

OBJECTIVE 27

Match the major parts of a cell to their correct functions.

1. **Nucleus**—Regulates cellular structure and activities, including reproduction of the cell (see Figure 5 on page 33)
2. **Cell membrane**—Allows some molecules to enter the cell while preventing entry by other molecules (see Figure 5 on page 33)

✔ **NOTE:** The cell membrane is sometimes referred to as the *plasma membrane*. The membrane exhibits selective **permeability**—it selects the chemicals that are allowed to pass through it, permitting some to pass in or out easily and keeping others out completely.

KEY TERM

Permeability (puhr-me-uh-bil´-uht-e)—The characteristic of a material to allow other substances to pass through it

✔ **NOTE:** An important function of a cell is to take in substances such as oxygen and nutrients and to release substances such as carbon dioxides and enzymes. However, the membrane must prevent substances such as toxins from entering the cell. For this reason, the cell membrane is said to be *selectively permeable*.

3. **Cytoplasm**—Provides structure to the cell and supports other parts of the cell (see Figure 5 on page 33)

✔ **NOTE:** The cytoplasm contains a number of specialized structures referred to as *organelles* (or-guh-nels´). The remaining parts listed in this objective are organelles.

4. **Endoplasmic reticulum** (en´-duh-plaz-mik re-tik´-yu-luhm)—Provides a passageway for the transport of materials within the cell and synthesizes lipids

✔ **NOTE:** The endoplasmic reticulum winds through the cytoplasm, delivering proteins and other chemicals to various parts of the cell and to other organelles. There are two types of endoplasmic reticula: smooth and rough (see Figure 5 on page 33). The bumpy appearance of rough endoplasmic reticulum is created by the ribosomes—another type of organelle—that attach to it. Smooth endoplasmic reticulum lacks ribosomes.

5. **Ribosome** (ri´-buh-som)—Synthesizes protein

✔ **NOTE:** The ribosomes are attached to the endoplasmic reticula and are scattered throughout the cell (see Figure 5 on page 33). The ribosomes contain RNA and play a key role in cell division.

6. **Golgi apparatus** (gol´-je ap-uh-rat´-uhs)—Synthesizes carbohydrates and packages materials to prepare them for secretion from the cell

✔ **NOTE:** The Golgi apparatus (see Figure 5 on page 33) generally lie near the terminal ends of endoplasmic reticula and receive the proteins produced by the endoplasmic reticula and ribosomes. This protein material is delivered in small bubble-like packets called *vesicles* (ves´-i-kuhls) (see Figure 5 on page 33). In the Golgi apparatus, the proteins are modified for special purposes, such as serving as pores in the cell membrane or as enzymes to be secreted from the cell. Once the proteins have been processed by the Golgi apparatus, they are released in vesicles for transport to their destination.

7. **Mitochondrion** (mit-uh-kawn´-dre-uhn)—Produces ATP and serves as the site of cell respiration

   ✔ **NOTE:** The mitochondria generate the energy required by the cell. They consist of a smooth outer sac that contains an inner sac partitioned by numerous folds called *cristae* (see Figure 5 on page 33). The mitochondria are rich in fats, proteins, and enzymes. The more energy that a cell requires to perform its functions, the more mitochondria the cell is likely to have.

8. **Lysosome** (li´-suh-som)—Contains the enzymes used to digest ingested material and damaged tissue (see Figure 5 on page 33)

9. **Centrosome** (sen´-truh-som)—Organizes special spindle fibers during cell division

   ✔ **NOTE:** Centrosomes consist of two cylinders called *centrioles* (see Figure 5 on page 33).

OBJECTIVE 28

Describe the major parts of a cell nucleus.

1. **Nuclear membrane**—A thickening of the outer surface of the nucleus protoplasm that regulates the movement of materials into and out of the nucleus

2. **Chromosome** (kro´-muh-som)—One of several strands of DNA that contains the genetic code that determines inherited traits

   ✔ **NOTE:** Human cells contain 23 pairs of chromosomes that carry the genetic code. When a cell is dividing to reproduce itself, the DNA molecules form tight coils so that they have the appearance of short rods. This is the chromosomal state. When the cells are not dividing, the DNA molecules have the appearance of granules or threads in the nucleoplasm and are referred to as *chromatin* (kro´-muht-uhn).

3. **Nucleolus** (nu-kle´-uh-luhs)—A dense spherical structure within the nucleus that is involved in protein synthesis and that forms ribosomal RNA (see Figure 5 on page 33)

OBJECTIVE 29

Describe the specialized structures in cells.

1. **Microvilli** (mi-kro-vil´-e)—Extensions of the cell cytoplasm that line the intestines (see Figure 5 on page 33)

2. **Flagellum** (fluh-jel´-uhm)—A single hair-like projection on a sperm cell

3. **Cilia** (sil´-e-uh)—Hair-like projections of the cells that form the mucous lining of the respiratory system and other passageways (see Figure 5 on page 33)

OBJECTIVE 30

State the functions of the specialized structures in cells.

1. **Microvilli**—Serve to increase the surface area of cells

   ✔ **NOTE:** The purpose of the intestines is to absorb nutrients. The reason that the small intestines twist around and fold back on themselves is to increase their length so that food being digested and absorbed will have to travel a greater distance, thus increasing the amount of intestine to which the nutrients are exposed. Microvilli serve the same purpose by presenting "fingers" into the interior of the intestines. This too increases the surface area to which nutrients are exposed.

2. **Flagellum**—Helps to propel a sperm cell so that it can reach an ovum

   ✔ **NOTE:** The sperm, or spermatozoa (spuhr-mat-uh-zo´-uh), is the male reproductive cell, while the ovum is the female reproductive cell. When an ovum is released for fertilization in the female, it is still beyond the point where sperm is deposited. This means that the sperm must "swim" the rest of the way to reach the ovum. The flagellum wiggles back and forth and whips around to propel the sperm toward the ovum.

3. **Cilia**—Help to propel fluid in one direction over the surface of cells

   ✔ **NOTE:** The cilia act like the bristles of a broom on a microscopic scale. Their sweeping motion moves fluids and transported substances along a passageway. For example, when the ovaries release an egg cell, cilia extending from the cells that line the interior of the fallopian tubes move the ovum toward the uterus. This increases the chances of fertilization by presenting the ovum to sperm cells and then to the uterus to be implanted or to be discharged if not fertilized.

OBJECTIVE 31

List the functions of a cell.

1. **To absorb materials to support cell functions**

   Examples: oxygen, nutrients

2. **To metabolize nutrients**
3. **To metabolize oxygen**
4. **To release energy**
5. **To synthesize protein**
6. **To excrete waste products**
7. **To reproduce itself**
8. **To support functions specific to that kind of cell**

   ✔ **NOTE:** The body contains hundreds of types of cells that serve specialized functions to support the purposes of the organ system in which the cells originate. The set of objectives in this module concentrates on the structure and chemistry of cells in general. The details of specific cell functioning will be provided in the modules that deal with the individual organ systems.

OBJECTIVE 32

Define the term *transport*.

- **Transport**—The movement of substances in and out of the cells

  ✔ **NOTE:** Depending on the type of cell, the substance, and the purpose of the movement, the method of transport can vary in a number of ways. However, the process can be generally divided into two categories: passive and active (see Objective 33).

OBJECTIVE 33

Distinguish between descriptions of the terms *active transport* and *passive transport*.

1. **Passive transport**—Movement that occurs without any energy being expended by the cell

   ✔ **NOTE:** In passive transport, chemicals move through the cell wall due to the mechanics of solutions. You have previously studied a general principle of fluid mechanics that states if two solutions are placed in a relationship in which materials can move between them, then there will be a flow of solvent from the area of lower concentration to the area of higher concentration until an isotonic state is reached. The word *passive* means that an action takes place without resistance to outside forces.

2. **Active transport**—Movement that requires the use of energy for the cell to transport the material through the cell wall

   ✔ **NOTE:** Active transport goes counter to the normal mechanics of solution. In other words, the solvent flows from the area of higher concentration to the area of lower concentration, causing the higher concentration to become even greater and the lower concentration to decrease further. This is somewhat like water running uphill. For active transport to take place, the cell must expend energy.

OBJECTIVE 34

Match types of passive transport to their correct descriptions.

1. **Diffusion** (dif-yu´-zhuhn)—The process by which particles in a fluid spread throughout the fluid to produce an equal concentration

   ✔ **NOTE:** Diffusion is the process that involves the flow of a substance from an area of higher concentration to one of lower concentration. Although this process is described as *passive*, all movement requires some form of energy. In this case, the energy is that of the atoms that make up the substance. The electrons that orbit the nucleus, the differences in electrical charges, and other forces cause atoms to be in continuous motion. In a solid, the movement is very slow. However, if a solid is dissolved in a liquid, many of the bonds that hold the substance in its solid shape are broken and the atoms and molecules of the substance move about with more freedom, bouncing off each other to further add to the motion. Substances in gaseous states are even more free to move about, which explains why an odor can so quickly fill a room.

2. **Osmosis** (awz-mo´-suhs)—The process by which solvent molecules pass through a semipermeable membrane to produce an equal concentration on each side of the membrane

   ✔ **NOTE:** Osmosis is actually a form of diffusion, one that involves a semipermeable or selectively permeable membrane. With osmosis, the emphasis is on the substances that are allowed to pass through the membrane. Similarly, filtration (see below) can be a form of osmosis in which the emphasis is on the prevention of movement of select substances. An example of osmosis is the flow of fluid into a cell if the electrolyte concentration within the cell gets too high.

3. **Filtration** (fil-tra´-shuhn)—The process by which solvents or specific particles are able to move through a membrane that prevents the passage of other solvents or particles

   ✔ **NOTE:** There are several filter systems in the body besides the cell walls. For example, the spleen filters blood that passes through it. Filtration requires force to move the solution through the filter. That force may be normal fluid mechanics forces or it may be an active force such as the heart pumping blood through the spleen.

OBJECTIVE 35

Match types of active transport to their correct descriptions.

1. **Physiological pump**—The process that moves molecules or ions through cell membranes against the pressure of natural forces

   ✔ **NOTE:** A physiological pump may be an organ like the heart. In active cell transport, the most-common form of physiological pump is a "carrier" molecule to which substances attach and are then carried in or out of the cell by movement of the carrier. An example is the sodium-potassium pump, which uses a molecule of sodium-potassium ATP to carry sodium ions out of the cells and potassium into the cells.

2. **Phagocytosis** (fag-uh-si-to´-suhs)—The process of a cell engulfing a solid particle with a portion of its membrane, which then breaks off from the membrane and migrates into the cell as a closed vesicle

   ✔ **NOTE:** During phagocytosis, the transported substance connects to receptor sites on the surface of the cell. The cell then draws in that portion of the cell wall and pinches it off to form a vesicle. The vesicle can then be moved about the cytoplasm as required. The same mechanism is used for pinocytosis (see below) except that the process involves a liquid rather than a solid. Phagocytosis and pinocytosis are sometimes collectively referred to as *endocytosis* (en-duh-si-to´-suhs) because materials are transported into the cell.

3. **Pinocytosis** (pin-uh-si-to´-suhs)—The process of a cell engulfing a liquid particle with a portion of its membrane, which then breaks off from the membrane and migrates into the cell as a closed vesicle

4. **Exocytosis** (ek-so-si-to´-suhs)—The process of a cell carrying substances in vesicles and secreting through the cell membrane

   ✔ **NOTE:** Exocytosis has previously been described in Objective 27 as part of the function of Golgi apparatus.

OBJECTIVE 36 **Complete statements that describe the process of cell growth.**

1. **Once a cell forms, it must produce additional cytoplasm and cell membrane as the cell enlarges.**

   ✔ **NOTE:** New cells are formed by the division of existing cells. This is followed by a growth period called the *interphase* (int′-uhr-faz).

2. **Part of the growth process involves protein synthesis through anabolism.**
3. **During protein synthesis, amino acids are bonded in polypeptide chains.**
4. **To create the polypeptide chains, a ribosome attaches to a complementary set of RNA molecules—a transfer RNA (tRNA) molecule and a messenger RNA (mRNA) strand—and holds them together during protein synthesis.**

   ✔ **NOTE:** The messenger RNA carries the genetic code that describes the type of protein to be constructed. The transfer RNA attracts amino acids based on the coding in the messenger RNA.

5. **The amino acids are drawn to the ribosome.**
6. **The ribosome secretes an enzyme that promotes the formation of a peptide bond.**
7. **The ribosome moves along the RNA strand pair building polypeptides.**
8. **In some cases, after the ribosome travels the full length of the RNA strands and moves on, enzymes present in the cell connect the polypeptides to form proteins.**
9. **Other enzymes cause the proteins to form cell membrane and organelles.**
10. **Mitochondria increase by self-replication.**
11. **Just before the cell begins to reproduce, the DNA also replicates itself.**

KEY TERM

Self-replication (self′ rep-luh-ka′-shuhn)—To produce a copy of oneself

✔ **NOTE:** Cells reproduce by replicating themselves and structures with the cells are also capable of dividing to make a copy of the structure. DNA replicates itself by splitting into two strands and then rejoining segments composed of new nucleotides joining each of the existing strands.

OBJECTIVE 37

Describe the types of cell reproduction.

✔ **NOTE:** Human cells undergo two types of division in order to reproduce. Mitosis (mi-to´-suhs) is the process used by virtually all cells, while meiosis (mi-o´-suhs) occurs only in reproductive cells.

1. **Mitosis** (see Figure 6 below)

   - Occurs in all human cells other than reproductive cells and nerve-tissue cells
   - Gives rise to two daughter cells that are identical to the parent cell
   - Consists of four distinct stages

   ✔ **NOTE:** The four phases of mitosis are (1) prophase, (2) metaphase, (3) anaphase, and (4) telophase. During prophase (pro´-faz), the cell prepares for division. The chromatids curl into dense chromosomes, the centrioles move to opposite ends (poles) of the cell and spindle fibers extend between them, and the nucleus dissolves. In the metaphase (met´-uh-faz), the spindle fibers have stretched from one end of the cell to the other and the chromosomes align across the midline of the cell at right angles to the spindle fibers, to which they attach. As the anaphase (an´-uh-faz) begins, the chromosome pairs (called *centromeres* [sen´-truh-mirz]) split and migrate toward opposite poles. The split of the centromeres results in the cell having sets of identical chromosomes in each half with each half having the same number of chromosomes as the original cell, and the cell begins to pinch in at the midline between the two poles. The final phase, or telophase (tel´-uh-faz), completes reproductive division by reversing the processes of the prophase in each half of the parent cell. A nucleus develops in each half, the chromosomes revert back to chromatids, and the spindle fibers disappear. Once these structures are all in place, the two halves split and two daughter cells exist in place of the split parent cell.

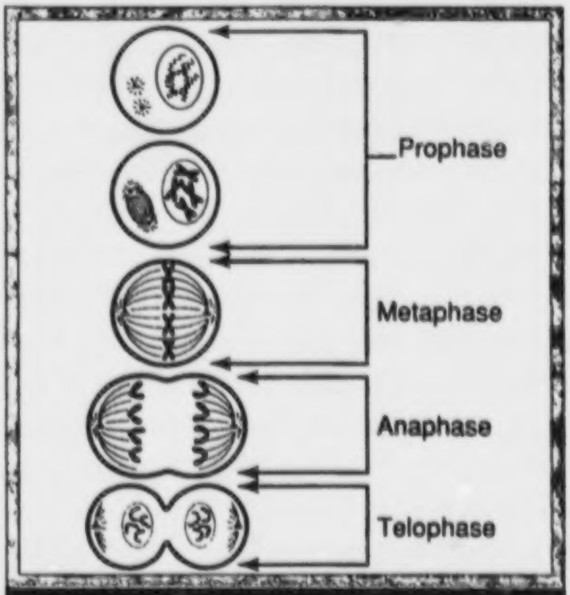

Figure 6
Types of cell reproduction: Mitosis

2. **Meiosis** (see Figure 7 below)

- Occurs in reproductive cells
- Gives rise to four daughter cells that each contain only half the number of chromosomes found in the parent cell
- Consists of two stages

✔ **NOTE:** The purpose of meiosis is to create reproductive cells that have only one half of the number of chromosomes normally found in the organism's cells. In this way, when the two reproductive cells unite, the resulting cell will have a full set of chromosomes. The first stage of meiosis is called *meiosis I* and begins with normal mitosis. In *meiosis II*, the process is repeated so that by the end of the second telophase, four cells have been produced. However, as the second stage begins, the two cells do not replicate their chromosomes as is done at the beginning of mitosis. Thus, the four cells produced have only half the number of chromosomes normally found in the organism's cells. The resulting cells are generally referred to as *gametes* (gam´-ets), though for male reproductive cells the process begins with spermatogonia (spuhr-mat-uh-go´-ne-uh) and produces spermatozoa and the process for female reproductive cells begins with oogonia (o-uh-go´-ne-uh) and produces one ootid and three polar bodies. The ootid has more cytoplasm than the polar bodies, which eventually disintegrate. This is something of a simplification of the two processes, but they will be discussed in more detail in later modules.

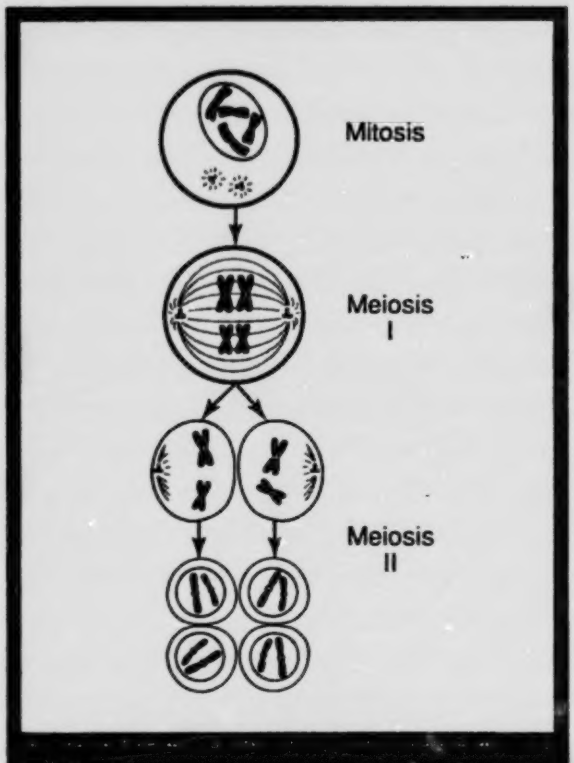

Figure 7
Types of cell reproduction: Meiosis

OBJECTIVE 38 **Describe the process in which the genetic makeup of a cell can be changed.**

1. **Exposure to certain conditions can disrupt the genetic makeup of a cell, resulting in a mutation.**

   ✔ **NOTE:** Conditions that cause mutations are called *mutagens.* The world around us is full of mutagens, some natural and some produced by human activities. Some mutations may be beneficial, which is part of the basis of the theory of evolution, which suggests that mutations that help an organism to adapt and survive are likely to be passed on to the organism's offspring. However, some mutations harm the organism or lessen its chances of survival.

2. **A mutation may lead to structural or functional disorders that are then passed on to daughter cells during mitosis.**

   ✔ **NOTE:** Many mutations are not passed on because the afflicted organism does not survive to reproduce or the mutation itself may leave the organism unable to reproduce. A number of mutations have been assimilated into the genetic code of individuals. For example, some persons are unable to see colors or are unable to distinguish between certain colors such as red and green and are said to be *color-blind.* Color-blindness is an inherited trait that probably started as a mutation. The condition sickle-cell anemia is an inherited condition in which a person's red blood cells are misshapen. Sickle-cell anemia probably began as a mutation. Cancer is also a common outcome of changes in the genetic makeup of cells. Cancer, which includes more than 100 varieties in humans, is always characterized by abnormal cell functioning. Malignant cancers exhibit uncontrolled cell division.

OBJECTIVE 39 **List the sources of mutation-causing conditions.**

1. **Exposure to chemicals**

   Examples: Inhaling asbestos; inhaling the tar that enters the lungs from smoking cigarettes

   ✔ **NOTE:** You know by now that our bodies are basically chemical containers in which reactions are taking place continuously. It should come as no surprise then that the introduction of foreign chemicals into the body can disrupt those reactions, including the reactions that transfer the genetic code. Such exposures may lead to illnesses, but they may also directly affect the genetic makeup of the cells.

2. **Exposure to energy sources**

   Examples: Exposure to radioactive materials; exposure to the ultraviolet light of the sun

   ✔ **NOTE:** Most skin cancers are the result of exposure to ultraviolet light. The energies emitted by radioactive materials can penetrate deep into the body and cause mutations in the genetic code. These energies can even reach the ova and sperm stored in the body and developing fetuses to cause mutations in offspring that did not result from the inheritance of those mutations through the genetic codes of the parents.

3. **Infections by other organisms**

   Example: Viruses that disrupt cell reproduction

   ✔ **NOTE:** Illness and infectious organisms may create chemical imbalances or toxic conditions in the body that disrupt normal reproduction.

OBJECTIVE 40 **Match the types of cellular respiration to their correct descriptions.**

✔ **NOTE:** Cell respiration is that part of metabolism that specifically deals with the conversion of glucose to produce energy in the cells (see Figure 8 on the next page). There are three types of cellular respiration: (1) glycolysis (gli-kawl´-uh-suhs), (2) aerobic oxidation (ar-o´-bik awk-suh-da´-shuhn), and (3) electron transport system.

1. **Glycolysis** (anaerobic oxidation)

   - Uses enzymes located in the cytoplasm
   - Does not require oxygen

     ✔ **NOTE:** *Anaerobic* means "without air or oxygen." Glycolysis does not use oxygen in its reaction. This is helpful to the cells if there is not enough oxygen available, as might occur with respiratory diseases or strenuous exercise.

   - Requires two molecules of ATP to start the reaction
   - Converts glucose and two ATP molecules into four ATP molecules, hydrogen, and energy

     ✔ **NOTE:** Glycolysis produces pyruvic (pi-ru´-vik) acid and, in a continuing reaction in the absence of oxygen, lactic (lak´-tik) acid. The lactic acid can later be converted back into pyruvic acid or glucose.

   - Requires the vitamin niacin
   - May develop into aerobic oxidation once oxygen is available

     ✔ **NOTE:** Once glucose has been converted into pyruvic acid, glycolysis can follow one of two paths. If there is still a shortage of oxygen, the reaction will continue along the path to produce lactic acid. However, if oxygen is available, the pyruvic acid will move to the mitochondria to be used in aerobic oxidation.

2. **Aerobic oxidation**

   ✔ **NOTE:** Aerobic oxidation is also called *Krebs cycle* or *citric-acid cycle.*

   - Uses enzymes located in the mitochondria
   - Requires oxygen

- Converts pyruvic acid into one ATP molecule, hydrogen, carbon dioxide, and carbon molecules
- Requires the vitamins thiamine, riboflavin, and niacin
- May continue through additional cycles as carbon combines with acetyl coenzyme A (uh-set´-uhl ko-en´-zim a)

3. **Electron transport system**

✔ **NOTE:** The electron transport system is also referred to as the *cytochrome* (sit´-uh-krom) *transport system.*

- Uses proteins located in the mitochondria
- Allows the electrons released by hydrogen atoms to react with cytochromes to generate enough energy to produce 34 ATP molecules from each glucose molecule
- Combines hydrogen and oxygen released from other forms of respiration to produce water
- Requires the vitamins riboflavin and niacin and the minerals iron or copper

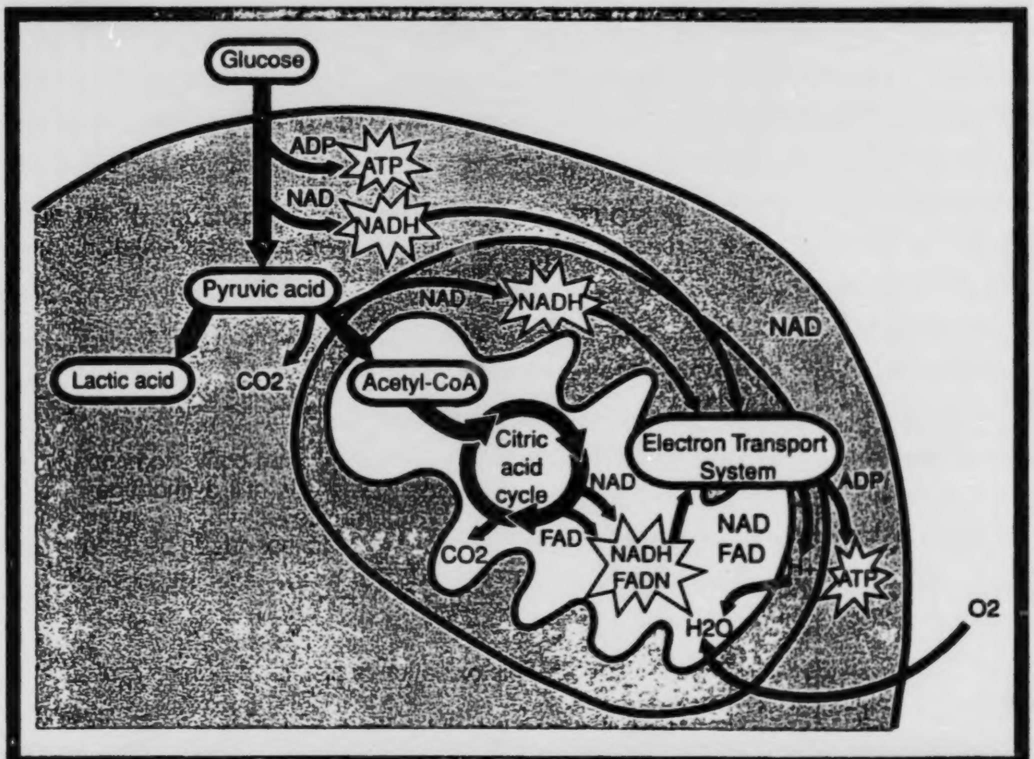
Glucose
ADP
ATP
NAD
NADH
Pyruvic acid
NAD
NADH
NAD
Lactic acid
CO2
Acetyl-CoA
Citric acid cycle
Electron Transport System
NAD
ADP
FAD
CO2
NADH FADN
NAD FAD
ATP
H2O
O2

Figure 8
Cell respiration

BEST COPY AVAILABLE

OBJECTIVE 41 **Arrange in order the levels in the taxonomy system used to classify organisms.**

✔ **NOTE:** Scientists use a system called *taxonomy* to classify all organisms based on their similarities and differences. The system contains seven major levels, beginning with the very broadest similarities and getting more specific until a single kind of organism is identified.

1. **Kingdom**

   ✔ **NOTE:** There are two major kingdoms: plants and animals. As advances in technologies have enabled scientists to discover more about microbiology and biochemistry, other kingdoms have been added, including fungi, protists (including most algae), and monera (including bacteria). Humans are classed in the animal kingdom.

2. **Phylum**

   Example: The human phylum is *Chordata.*

3. **Class**

   Example: The human class is *Mammalia.*

4. **Order**

   Example: The human order is *Omnivora.*

5. **Family**

   Example: The human family is *Primates.*

6. **Genus**

   Example: The human genus is *Homo.*

7. **Species**

   Example: The human species is *Sapiens.*

OBJECTIVE 42 **Match the types of relationships between organisms to their correct descriptions.**

✔ **NOTE:** Because we share the planet with each other, organisms form relationships with each other. Generally, these relationships may be classed as beneficial, harmful, or neutral. For example, you know that certain organisms can cause illness in humans. On the other hand, there are organisms that live in our intestines that help us to digest food. Still other organisms seem to have little or no interaction with humans. The terms presented in this objective describe some of the more-important relationships that can exist between organisms.

1. **Symbiosis** (sim-bi-o´-suhs)—A relationship between two organisms that have close contact with each other

   ✔ **NOTE:** Symbiosis is a general term for any close relationship between organisms of different species, whether that relationship is beneficial or harmful or neither. The two organisms may simply live very near each other, the two organisms may have physical contact, or one organism may actually live on or within the other.

2. **Mutualism** (myuch´-uh-wuh-liz-uhm)—A relationship between two organisms that is beneficial to both

   ✔ **NOTE:** In a mutualistic relationship, the organisms maintain close contact with one another and both benefit from each other. For example, tick birds stay near herds of cattle or antelope. The birds feed on insects and other pests that bother the herd animals. Thus, both types of organisms benefit. The term *symbiosis* was once applied to this type of relationship but now has a broader meaning.

3. **Commensalism** (kuh-men´-suh-liz-uhm)—A relationship between two organisms in which one organism benefits and the other neither benefits nor is harmed

   ✔ **NOTE:** The remora fish that attach themselves to sharks, whales, and sea turtles provide no benefit to their hosts yet cause their hosts no real harm. However, the remora is able to eat bits of food that the host misses when feeding. In this way the remora benefits from the commensalistic relationship.

4. **Neutralism** (nu´-truh-liz-uhm)—A relationship between two organisms in which the organisms present no significant benefit or harm to each other

   ✔ **NOTE:** Squirrels and songbirds that live in the same tree share a neutralistic relationship. While there may be some competition for food and nest sites, the two species have little interaction. In parts of Africa, herds of animals, like zebras and wildebeests, travel and graze together. The increased herd size may allow a greater degree of alertness to danger from predators, but there is essentially no direct benefit to either type of organism.

5. **Parasitism** (par´-uh-suh-tiz-uhm)—A relationship between two organisms in which one organism is harmed by the presence of the other

   ✔ **NOTE:** Parasitism is an important concern to all health professionals. The organisms that cause diseases in humans are generally parasites. Additionally, disease-carrying organisms such as fleas and ticks are parasitic on humans.

6. **Pathogenic** (path´-uh-jen-ik)—A relationship between two organisms in which one organism is capable of causing a disease in the other organism

   ✔ **NOTE:** There are organisms that live inside humans in mutualistic relationships. They are nonpathogenic. However, other organisms that enter the body can cause a variety of diseases, generally through the production of toxins that disrupt normal cell functioning.

OBJECTIVE 43 **Describe the classes of microorganisms.**

1. **Bacterium** (bak-tir´-e-uhm)—A widely distributed **unicellular** organism that may or may not cause disease

   ✔ **NOTE:** The plural of bacterium is *bacteria*. There are three primary ways of classifying bacteria. They are classified by their shape (see Objective 44), by their arrangements, and by whether they require oxygen (aerobic) or not (anaerobic).

2. **Virus** (vi´-ruhs)—A subcellular organism that reproduces as a parasite within other organisms and, consequently, is pathogenic

✔ **NOTE:** Viruses are smaller than bacteria. They consist of DNA or RNA within a protein shell; the protein shell of each virus has a distinct shape. During reproduction, the virus enters a cell in the **host** and uses the chromosomes and enzymes in the cell to replicate itself. The cell will then die. The severity of the disease depends on the kind of cell that is infected. Rabies, chicken pox, measles, influenza, cold sores, polio, and certain tumors are all the result of viruses.

KEY TERMS

Unicellular (yu-ni-sel´-yuh-luhr)—Consisting of one cell

Host (host´)—The organism that provides the resources required to sustain a parasitic relationship

3. **Protozoan** (prot-uh-zo´-uhn)—A unicellular organism that is adapted for life in water and forms **cysts** that pass from host to host

✔ **NOTE:** The plural of protozoan is *protozoa*. Many protozoa are pathogenic to humans. Some, such as those that cause **amebic dysentery** and **giardiasis**, are contracted by consuming infected food or water. Others, such as those that cause **malaria**, are spread by other organisms, such as mosquitoes.

KEY TERMS

Cyst (sist´)—A capsule that forms around microorganisms before they enter dormant periods

✔ **NOTE:** Some microorganisms enter periods in which they are inactive, often because environmental conditions may not be favorable to them, such as during a drought. Cysts are also used to protect the organism as it moves from host to host, especially for parasites that require multiple hosts.

Amebic dysentery (uh-me´-bik dis-uhn´-ter-e)—A condition of severe diarrhea often accompanied by blood and mucus that results from an infection of protozoa

Giardiasis (je-ar-di´-uh-suhs)—A condition of diarrhea caused by drinking water containing giardia

Malaria (muh-ler´-e-uh)—A parasitic infection of red blood cells by plasmodium virus transmitted by the bite of certain species of mosquito

4. **Fungus** (fuhn´-guhs)—A unicellular or multicellular organism that reproduces by means of spores and that may be pathogenic or nonpathogenic

✔ **NOTE:** The plural of fungus is *fungi*. Many fungi, such as molds and mushrooms, live on dead matter and help to decompose it. Unicellular fungi are called *yeast,* and many of them are pathogenic to humans, causing yeast infections in moist areas of the body, athlete's foot, ringworm, and other conditions. In some cases, persons with weakened immune systems may experience serious illness and even death from inhaling **spores** that infect the pulmonary regions. A yeast-induced illness is called a *mycosis* (mi-ko´-suhs).

KEY TERM

Spore (spor´)—The dormant form of a bacterium or the reproductive form of a fungus

5. **Worm** (wuhrm´)—A multicellular organism that in its parasitic form can be pathogenic to humans

✔ **NOTE:** Generally referred to as *helminths* (hel´-minths) in the medical profession, parasitic worms can produce very serious **infestations** because they live inside the body and feed on the host's blood and nutrients. Many go through several life stages only some of which are parasitic or that require different hosts for each stage. Flukes, tapeworms, pinworms, and hookworms are examples of helminths that infect humans.

KEY TERM

Infestation (in-fes-ta´-shuhn)—The presence of parasites in the environment, on the skin, or in the hair of a host

6. **Arthropod** (ar´-thruh-pawd)—An **invertebrate** organism with six or more jointed legs and an **exoskeleton**

✔ **NOTE:** All insects, arachnids (such as spiders), and creatures such as lobsters and crabs are arthropods. Some arthropods are parasitic on humans, including ticks, lice, and mites. Many, such as bees, spiders, and scorpions, carry toxins that can be harmful to humans, especially persons with **allergies** to arthropod venom. Arthropods such as ticks, fleas, flies, and mosquitoes can present additional risks to humans by carrying infectious organisms that enter the bloodstream when the arthropod bites.

KEY TERMS

Invertebrate (in-vuhrt´-uh-brat)—An organism that does not have an internal skeleton and, specifically, a spinal column

Exoskeleton (ek-so-skel´-uht-uhn)—A characteristic of some organisms in which the outer tissue of parts of the body are hardened to the point that they support attached softer tissues

Allergy (al´-uhr-je)—A condition of being highly sensitive to foreign substances that enter the body often because the person's immune system does not respond to the antigen of the substance

OBJECTIVE 44 **Label the classes of microorganisms as classified by their shape.**

✔ **NOTE:** One of the means of classifying bacteria and some other unicellular organisms is by their shape. Three of the common microorganism shapes—bacillum (buh-sil'-uhm), coccus (kawk'-uhs), and spirillum (spi-ril'-uhm)—are illustrated in Figures 9 through 11 below. A bacillum is any rod-shaped bacterium; a coccus is any round, spherical, or oval bacterium; and a spirillum is any coiled bacterium.

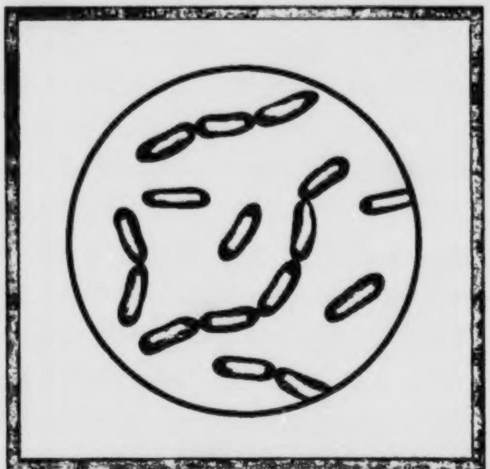

Figure 9
Bacillum

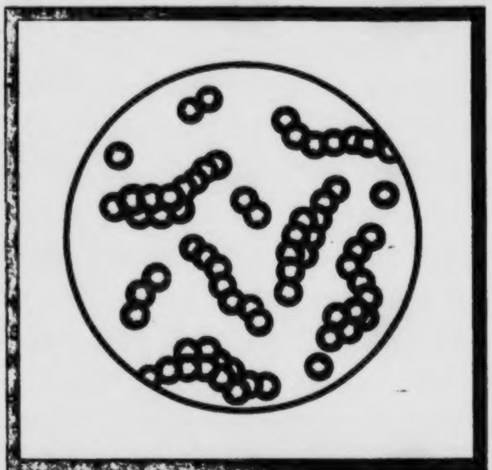

Figure 10
Coccus

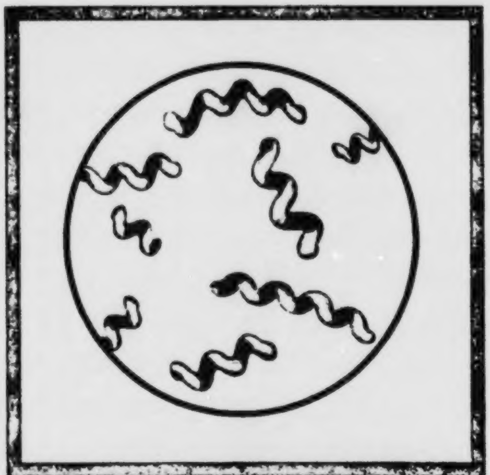

Figure 11
Spirillum

OBJECTIVE 45

Define the terms *resident flora* and *transient flora*.

✔ **NOTE:** While some organisms are pathogenic to humans, many live in the body or on its surface in mutualistic or commensalistic relationships. These organisms are referred to as *resident flora*. Those organisms that inhabit the body temporarily are referred to as *transient flora*. In some cases, a resident flora will become pathogenic. Typically, this happens when the population of some other resident flora has declined, allowing the organism that becomes pathogenic to multiply well beyond its normal number. An organism that takes advantage of a temporary situation to spread is called an *opportunist*.

1. **Resident flora** (rez´-uh-dent flor´-uh)—Organisms that normally live in and on the bodies of healthy persons without causing harm when located in specific sites
2. **Transient flora** (tranz´-e-uhnt flor´-uh)—Organisms that take up residence in or on the body temporarily in a location where they are not normally found

OBJECTIVE 46

Describe the purpose of a gram stain.

■ **A gram stain identifies the shape of a pathogen and indicates a positive or negative characteristic of the pathogen that allows preliminary identification of the organism as an aid to diagnosis.**

✔ **NOTE:** The identification and treatment of a disease often depends on interpreting a limited number of clues, such as a person's symptoms. Another clue is the identification of the pathogenic organism involved. One method of identifying bacteria is the gram stain, in which an infected sample, such as saliva, is treated with a dye and examined under a microscope. The shape and color of the organism is apparent under the microscope. Depending on whether the bacteria turn a bluish color or a reddish color, the bacteria can be classed as either gram negative or gram positive. Since a genus will react as either positive or negative and a shape may be particular to a genus or species, the gram-stain test is often enough to specifically identify an organism.

OBJECTIVE 47

Complete statements that describe the characteristics of bacteria.

1. **The tough outer cell wall gives a bacterium its shape.**
2. **Cocci and bacilli often colonize with each other so that another way of identifying bacteria is by the shape of their colonies.**

   ✔ **NOTE:** The shape of the bacterial groups is added as a prefix to the shape of the organism. Thus, cocci that forms clusters are called *staphylococcus* (staf-uh-lo-kawk´-uhs), those that form chains are called *streptococcus* (strep-tuh-kawk´-uhs), and those that form pairs are called *diplococcus* (dip-lo-kawk´-uhs). There are also strepto- and diplo- forms of bacilli.

3. **Bacteria reproduce by binary fission, in which the chromosome duplicates itself and then the cell divides into two identical cells.**
4. **Aerobic species require that oxygen be present in order to reproduce.**
5. **Anaerobic species require that no oxygen be present in order to reproduce.**
6. **Facultative anaerobic species can reproduce with or without oxygen.**

KEY TERM

Facultative (fak'-uhl-tat-iv)—Having the ability to adapt to more than one condition

OBJECTIVE 48

Complete statements that describe the characteristics of rickettsiae.

1. **Rickettsiae** (rik-et'-se-uh) **are bacteria that can reproduce only within the cells of a living host.**
2. **Rickettsiae infect mammals and are often spread by arthropods.**

   ✔ **NOTE:** Two rickettsial diseases include Rocky Mountain spotted fever and typhus, spread by ticks and lice respectively.

3. **Rickettsiae infections can be treated with antibiotics.**

OBJECTIVE 49

Complete statements that describe the characteristics of viruses.

1. **Viruses are nucleic acids within shells of protein.**
2. **Each virus exhibits a shape that is characteristic of that virus.**
3. **Viruses can only reproduce when they are within the living cells of a host organism.**
4. **A virus will use the nucleic acid and enzymes of an infected cell to produce other viruses, often multiplying to the point that the host cell ruptures and dies.**
5. **The severity of a viral disease depends on the type of cells that are infected.**
6. **Some viruses can become dormant so that they present no signs of infection and then become active again after a period of time, even years later.**
7. **Some viruses can be transmitted from a pregnant woman to her fetus.**
8. **Antiviral medications are difficult to develop because viruses reside inside cells, use the cell's chemicals to reproduce, and offer few functions that can be attacked without harming the host organism.**

OBJECTIVE 50

Complete statements that describe the characteristics of protozoa.

1. **Protoza are unicellular.**
2. **Protoza live in water and soil.**
3. **Protoza can form cysts and become dormant.**
4. **Protoza generally spread from food or water contaminated with cysts.**

OBJECTIVE 51 **Complete statements that describe the characteristics of fungi and algae.**

✔ **NOTE:** Fungi (fuhn´-ji; singular *fungus,* fuhn´-guhs) and algae (al´-je) are two types of plants. They are distinct from each other primarily in that alga has chlorophyll in its cells and can produce its own nourishment in the presence of light. Fungi do not have chlorophyll and must extract their nutrition from an external source, such as decaying organic matter or a live host. Both types of organisms are simple plants and are not differentiated into complex structures such as root systems and leaves. Many types of fungi are capable of infecting humans. Infections with algae are extremely rare with fewer than 100 cases reported in humans.

1. **Fungi**
   - Fungi may be unicellular or multicellular.
   - Some fungi are normally found in and on the body.
   - Fungi infections may result from the use of antibiotics or reduced resistance due to injuries or diseases.
   - Most fungi infections are superficial but can spread to the inside of the body through spores.
2. **Algae**
   - Algae may be unicellular or multicellular.
   - Infestation generally occurs as a result of a break in the skin or a trauma, including surgery, and is generally limited to the skin or bursa.
   - The most-common symptom is skin lesions that resemble many other conditions so that the diagnosis must be confirmed through laboratory analysis.

OBJECTIVE 52 **Complete statements that describe common parasites that afflict humans.**

1. **Parasitic worms live off nutrients in the host's body, in the host's blood, or on the host itself.**
2. **Many parasitic worms have several stages of life involving eggs, larvae, and adult stages.**
3. **Parasitic worms generally inhabit specific body sites.**
4. **For some species of parasitic worms, the inhabited site varies with the stage of development and may even involve more than one host species.**
5. **Mites and lice generally afflict the surface of a host's body and present little direct risk to the host.**
6. **Parasites such as lice, fleas, mosquitoes, and ticks may be vectors of disease.**

KEY TERM

Vectors (vek´-tuhrs) **of disease**—The conditions that tend to promote the spread of a disease, such as when the bite of an arthropod allows pathogens to enter a person's bloodstream

OBJECTIVE 53

Assignment Sheet 1—Practice Critical Thinking: Complete Biochemistry and Microbiology Case Studies

Name ______________________________ Date ______________

Evaluation criteria	Rating
• Directions were followed	______
• Answers demonstrate an understanding of the information presented in the Information Sheet	______
• Complete sentences were used in answering each case study	______
Overall rating	______

Evaluator's comments ____

____

____

INTRODUCTION

Biochemistry and microbiology play important roles in health care. As you have learned in this module, our bodies are containers for a number of chemicals. The performance of these chemical engines is easily affected by chemicals that enter the body and by invasions by microorganisms. For these reasons, it is as important that you have an understanding of how chemical reactions within the body react to these outside influences as it is that you have an understanding of the body's normal activities.

EXERCISE

ACTIVITY CHECKLIST

Put a checkmark on the blank line before each activity below as you complete it.

______ 1. Review the objectives in the Information Sheet.

______ 2. Read each case study below.

______ 3. Use the information provided in the Information Sheet and from outside resources to answer the questions in each case study. Use complete sentences in your answers.

______ 4. Complete the assignment and give it to your instructor for evaluation.

Case Study 1

Patients often receive solutions intravenously while in the hospital. These solutions may include nutrients or medications in water. The solution generally has salts dissolved in the water. Why is this done?

Case Study 2

Mr. Rodriguez has a respiratory infection. Tests have been made of his oxygen capacity. The tests show that Mr. Rodriguez's lungs are not taking in enough oxygen nor are they getting rid of carbon dioxide efficiently. Considering this situation, what do you expect to happen to the pH value of the patient's blood and why?

Case Study 3

Many people today consume "sports drinks" when they exercise. These drinks contain electrolytes and are intended to replace those lost during exercise. Does this seem like a good practice? Why or why not?

CASE STUDY 4

Mrs. Cunningham has been diagnosed with osteoporosis. What chemical is the patient's body lacking or failing to process adequately? How does this lead to Mrs. Cunningham's condition?

CASE STUDY 5

Judy Phan is a 14-year-old girl who has been diagnosed with anemia. What could be some of the contributing factors and what mineral is Miss Phan's doctor likely to prescribe?

CASE STUDY 6

Arthropods can be vectors of disease. Are there organisms in your area that present a risk as vectors of disease? What is the organism and what is the associated disease that pose a threat in your area?

MODULE SET I: Introduction to Anatomy and Physiology

Module 3: Infection, Immunology, and Sanitation

Module Contents

COMPONENTS

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Module Objective Sheet 5
Information Sheet 7
Assignment Sheet
1—Practice Critical Thinking: Complete a Case Study on Immunity and Infection 33

PREREQUISITES:
Module 2

Learning Activities Sheet

Student name ______________________________

DIRECTIONS

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objectives 1 through 35.

☐ 5. **Research** Online resources to learn more about infection, immunology, and sanitation. Your instructor will list several web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 6. **Take** Written Test provided by your instructor.

☐ 7. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, repeat steps 4 through 6.

☐ 8. **Do** Assignment Sheet 1, "Practice Critical Thinking: Complete a Case Study on Immunity and Infection."

☐ 9. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 10. If the evaluation is not satisfactory, repeat step 8.

☐ 10. **Check** With your instructor for any additional assignments to be completed.

☐ 11. **Do** Additional assignments your instructor lists below.

____

____

____

☐ 12. **Take** Module Review provided by your instructor.

☐ 13. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 14. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheet, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

Module Objective Sheet

UNIT OBJECTIVE

After completing this module, you should be able to name the sources of the microorganisms that cause disease, describe the body's defense-mechanism processes, and describe methods used to control the spread of microorganisms. You should demonstrate these competencies by completing the assignment sheet and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

SPECIFIC OBJECTIVES

After completing this module, you should be able to

1. Define the term *infection.*
2. Complete statements that describe the effects of infection on a human host.
3. Complete statements that describe methods used to reduce the spread of infection.
4. Match types of infections and diseases to their correct descriptions.
5. Define the phases in the course of a disease.
6. Complete statements that describe the role of the body's portals of entry and portals of exit in the spread of infectious diseases.
7. List sources of the microorganisms that cause infectious diseases.
8. List the factors that determine whether a pathogen will cause a disease in a host's body.
9. Define the factors that influence the virulence of a pathogen in a host's body.
10. State the functions of the body's physical barriers to infection.
11. State the functions of special structures, chemicals, and actions within the body that provide protection against infection.
12. Define the term *immunology.*
13. Define the types of immunity.
14. Define the types of cellular and tissue defense-mechanism processes the body uses against disease and infection.
15. Match types of white blood cells to their correct descriptions.
16. Describe the stages of the interferon response.
17. Describe the stages of phagocytosis.
18. Distinguish between the definitions of a T cell and a B cell.

19. Match types of T cells and B cells to their correct functions.

20. Distinguish between descriptions of the types of immunity development in the serum-protein response.

21. Describe the stages of cell-mediated immunity development in the serum-protein response.

22. Describe the stages of humoral-mediated immunity development in the serum-protein response.

23. Define the phases of the antibody-production cycle that follows the body's exposure to an antigen.

24. Describe the stages of the inflammatory reaction.

25. Match types of vaccines to their correct definitions.

26. Define the term *hypersensitive response.*

27. Define the types of hypersensitive responses.

28. Match methods used to control the spread of microorganisms to their correct definitions.

29. State reasons certain industries must control the growth of microorganisms.

30. Describe the factors that determine the effectiveness of an antimicrobial procedure.

31. Match types of antimicrobial-control methods to their correct descriptions.

32. List factors that contribute to the spread of nosocomial infections.

33. Match organisms that cause common nosocomial infections to the infections they cause.

34. Describe types of patient isolation used in health-care facilities.

35. Complete statements that describe recommended precautions and guidelines used in surgical suites to reduce the spread of infection.

36. Practice critical thinking: complete a case study on immunity and infection. (Assignment Sheet 1)

Information Sheet

OBJECTIVE 1 **Define the term *infection*.**

- **Infection** (in-fek´-shuhn)—An invasion of a body by organisms and the reaction of the body to the presence of those organisms and to the **toxins** that they produce; the presence and multiplication of an organism that results in harm or **disease** to a **host**

✔ **NOTE:** Very small organisms—referred to as *microorganisms* (mi-kro-or´-guh-niz-uhm)—can enter the body during respiration, ingestion, and sexual contact; through wounds; and by other conditions that provide openings into the body (see Objective 6).

KEY TERMS

Toxin (tawk´-suhn)—A substance that is harmful to cells

Disease (diz-ez´)—A specific illness or disorder characterized by a recognizable set of signs and symptoms and attributable to heredity, infection, diet, or environment

Host (host´)—An organism that serves as a permanent or temporary home for another organism

OBJECTIVE 2 **Complete statements that describe the effects of infection on a human host.**

1. **The harmful effects of an infection on a host may be the direct result of an action taken by a pathogen or the result of toxins produced by the pathogen.**

   ✔ **NOTE:** An infecting organism generally causes illness by disrupting the normal activities of a host's cells and, thus, organs.

KEY TERM

Pathogen (path´-uh-juhn)—An organism that is capable of producing disease in another organism

2. **The ability of an infecting organism to harm a host is referred to as *virulence*** (vir´-{y}uh-luhns).

   ✔ **NOTE:** An infecting organism's virulence depends on a number of factors, such as how the organism enters the body, the number of invading pathogens, and other conditions. You will study these factors in Objective 9.

3. **The ability of a host to avoid infection and reduce harm caused by an infecting organism is called *resistance*** (ri-zis´-tuhns).

   ✔ **NOTE:** The resistance of a host depends on a number of factors, such as general health, age, sensitivity to the pathogen, and other factors. You will study thee factors in Objectives 8 and 9.

4. **An infection may result in observable symptoms in a host, or the infection may occur without symptoms.**

KEY TERM

Symptom (sim(p)´-tuhm)—A condition that occurs in association with a disease and that can be evidence of the presence of the disease

Examples: Fever, chills, sluggishness, rash, loss of appetite, watery eyes

5. **The period of time between the incidence of infection and the appearance of symptoms in a host is referred to as the *incubation*** (in-kyuh-ba´-shuhn) ***period.***

6. **An infection in a host may be localized, limited to only one organ or site, or it may be systemic, affecting the entire body.**

7. **The host's body produces special cells that recognize pathogens and destroy them.**

   ✔ **NOTE:** You will study these cells and their responses in later objectives in this moduie.

8. **Communicable** (kuh-myu´-ni-kuh-buhl) **diseases are infections that can be spread from one human host to another through direct or indirect contact.**

   ✔ **NOTE:** You will study ways to prevent the spread of infection in Objective 3 and in later objectives in this module.

OBJECTIVE 3 **Complete statements that describe methods used to reduce the spread of infection.**

1. **The spread of infection can be reduced by using antiseptic practices, cleaning with disinfectants, and sterilizing instruments and surgical materials.**

KEY TERMS

Antiseptic (ant-uh-sep´-tik)—A chemical used to destroy or reduce the growth of pathogens on a person

Disinfectant (dis-uhn-fek´-tuhnt)—A chemical used to destroy or reduce the growth of pathogens on objects

Sterilize (ster´-uh-liz)—To destroy all of the pathogens on an object or in a substance

2. **Some infections can be prevented through vaccinations.**

3. **Once an infection has occurred, antibiotics can be used to improve the body's ability to fight the infection.**

KEY TERMS

Vaccination (vak-suh-na´-shuhn)—The administration of a medication that increases the body's resistance to a specific pathogen

Antibiotic (ant-i-bi-awt´-ik)—A special medication that slows or stops the growth of certain microorganisms

OBJECTIVE 4 **Match types of infections and diseases to their correct descriptions.**

1. **Localized infection**—An infection that involves only one organ or site of a host's body

   ✔ **NOTE:** A localized infection may also be referred to as a *local infection.*

2. **Systemic infection**—An infection that has spread throughout a host's body from an initial site

3. **Acute** (uh-kyut´) **infection**—An infection that runs a rapid and severe course and then ends abruptly

   Examples: Cold, measles, influenza

4. **Chronic** (krawn´-ik) **infection**—An infection that lasts for a long period of time—from weeks to several years

   Examples: Advanced tuberculosis, acquired immunodeficiency syndrome (AIDS)

5. **Latent** (lat´-uhnt) **infection**—An infection that has no apparent symptoms

   Examples: Malaria, early tuberculosis

6. **Mixed infection**—An infection that results from more than one organism

   Examples: Appendicitis, wound infections

7. **Nosocomial** (nos-uh-ko´-me-uhl) **infection**—An infection that is contracted in a hospital or other health-care facility, such as a nursing home

   ✔ **NOTE:** Caregivers can come into contact with diseases that infect the persons to whom they provide care. The infectious contamination can result from direct contact with the patient or client, through handling their body fluids (blood, urine, stools, saliva, mucus, etc.), or by touching objects that have been contaminated through contact with the patient, including clothing, bedding, bandages, dishes, and such. The caregiver may become infected or may transfer the infection to other caregivers or to patients or clients. Nosocomial infections often result from poor health-care practices.

8. **Primary disease**—The first-occurring infection within a period of illness
9. **Secondary disease**—A subsequent infection or complication to an existing condition

✔ **NOTE:** An illness may lower a person's resistance to fight other infections, allowing other organisms to become established. For example, patients who are confined to a bed for a long period of time are more likely to contract pneumonia, an inflammation of the lungs that may result from infections by microorganisms.

OBJECTIVE 5

Define the phases in the course of a disease.

1. **Incubation**—The period of time between the incidence of an infection and the appearance of symptoms in a host
2. **Illness**—The period of time during which a host exhibits symptoms of a disease

✔ **NOTE:** Some authorities divide the illness phase into two phases called the *prodromal* (pro-dro´-muhl) *phase* and the *acute phase*. The prodromal phase is a short period—usually less than a day—during which time the infection has been established but symptoms are not fully developed. The host may not feel well, but symptoms such as nausea and fever that are to follow are not yet evident. The acute phase is the time during which the symptoms are pronounced.

3. **Convalescence or death**—The resolution of a disease, resulting in a host's recovery or death

KEY TERM

Convalescence (kawn-vuh-les´-uhns)—The process of a host's recovering from a disease

✔ **NOTE:** Most illnesses are called *self-limiting*—the body's defenses will overcome the illness in a short time, or the disease is caused by a pathogen that has only a short life cycle within the body. Some illnesses require the use of medications to assure recovery. In some cases, a host does not recover quickly, and some diseases can lead to the host's death. If the disease is not fatal—it does not lead to the host's death—the host may remain afflicted, with the disease becoming chronic. Often chronic illnesses do not lead directly to death, but they may allow secondary infections that can lead to death or that are fatal to the host because of his or her weakened condition from dealing with the chronic condition.

OBJECTIVE 6

Complete statements that describe the role of the body's portals of entry and portals of exit in the spread of infectious diseases.

✔ **NOTE:** Infections enter the body through openings called *portals of entry*. A portal of entry may be a natural opening, such as the mouth, or an injury, such as a cut. Infections can be communicated to others through openings called *portals of exit*. For example, when a **contagious** person sneezes, pathogens can exit with the mucus and droplets expelled from the nose.

KEY TERM

Contagious (kuhn-ta´-juhs)—Communicable, such as a disease that may be transmitted by direct or indirect contact

1. **The most-common portals of entry for pathogens are breaks in the skin and natural body openings such as the nose, mouth, and genitourinary openings.**

2. **The most-common portals of exit for pathogens are skin lesions and natural body openings such as the nose, mouth, and genitourinary openings.**

   ✔ **NOTE:** Pathogens are spread by persons coming into contact with the body fluids that leave by means of an infected person's portals of exit. Blood may be transferred from an open wound or by infected needles and instruments. Fecal material and urine can carry pathogens. **Sputum** and saliva carry pathogens from the lungs and mouth. Tears can transmit infections of the eyes. Semen and vaginal secretions can spread pathogens through sexual contact. Breast milk can transmit diseases from a woman to a nursing infant. Other fluids may also contain pathogens that can infect a second person if contact with a portal of entry occurs.

3. **Typically, a disease will spread from an infected host's portals of exit to a second host's portals of entry.**

4. **Hosts who have recovered from a disease or who are asymptomatic may be carriers and transmit the disease to others.**

KEY TERMS

Genitourinary (jen-uh-to-yur´-uh-ner-e)—Referring to the structures and processes associated with urinary functions and reproduction

Lesion (le´-zhuhn)—A separation in tissue

✔ **NOTE:** A lesion may be the result of a mechanical injury such as a cut or surgical incision, or it may be the result of an infection that causes the flesh to tear.

Sputum (sp(y)ut´-uhm)—Substance expelled from the respiratory tract that may contain mucus, pus, cellular materials, blood, and other materials

Asymptomatic (a-sim(p)-tuh-mat´-ik)—Being without symptoms

Carrier (kar´-e-uhr)—An organism capable of spreading disease

✔ **NOTE:** A carrier may exhibit symptoms of the disease or may be asymptomatic.

5. **Zoonoses spread to humans from animals.**

KEY TERM

Zoonosis (zo-uh-no´-suhs)—A disease of animals that is transmissible to humans from its primary animal host

Examples: Equine encephalitis, rabies, and yellow fever

6. **Pathogens that live in the soil, on other surfaces, or in contaminated foods can also enter the body through portals of entry.**

OBJECTIVE 7 **List sources of the microorganisms that cause infectious diseases.**

1. **Living hosts**

   ✔ **NOTE:** Living hosts can transmit a pathogen from itself to another host.

2. **Inanimate objects or materials**

   Examples: Transmission of a pathogen by a host's consuming contaminated food or water or contacting **fomites** such as contaminated drinking cups and eating utensils

KEY TERMS

Inanimate (in-an´-uh-muht)—Nonliving

Fomite (fo´-mit)—An inanimate object that is contaminated with pathogens and is capable of transmitting pathogens to a human host

OBJECTIVE 8 **List the factors that determine whether a pathogen will cause a disease in a host's body.**

1. **Site of the pathogen invasion**

   ✔ **NOTE:** The portal of entry of the pathogens and the site where the pathogens settle inside the body may determine whether the pathogens will cause illness. Some organisms are only infectious if they enter by a given portal of entry. For example, a host's swallowing the pathogens for malaria will not lead to infection because malarial organisms can only flourish if they enter through the bloodstream. Other organisms must reach a certain site within the body in order to survive.

2. **Antibacterial techniques**

   ✔ **NOTE:** Steps can be taken to reduce the risk of infection through antibacterial techniques. For example, if a person suffers a slight cut while using a knife, the wound should be washed and treated with an antibiotic. The wound may also be dressed—cleaned, medicated, and covered—to protect it and to prevent dirt and other contaminants from entering it.

3. **Normal flora**

✔ **NOTE:** The resident flora in and on the surface of our bodies offer some protection against infections because they are likely to be competitors with an invading pathogen. In many cases, the presence of normal flora will prevent the transient organism from becoming established. However, surgery or medications may reduce the population of resident flora, allowing the pathogens to spread, as when yeast infections occur as a result of the administration of antibiotics that reduce the population of resident flora on the skin.

4. **Bacteriocidins**

Key Term

Bacteriocidin (bak-tir´-e-o-si-din)—A medication that kills bacteria

✔ **NOTE:** While bacteria are a specific type of microorganism, the term *bacteria* is sometimes applied in a general way to any microscopic pathogen.

5. **Antibodies**

Key Term

Antibody (ant´-i-bawd-e)—A specialized protein produced in the blood plasma in response to bacteria, viruses, or other antigenic substances

✔ **NOTE:** Antibodies respond to specific structures on the outside of cells that indicate the cell's source. Cells within each host's body are marked as "self" cells by these structures or as antigens (ant´-i-juhns). The antigens of an invasive cell show that it is not part of the self. Upon detecting the antigen of a pathogen, the body will create an antibody that matches the antigen of the invasive organism. The antibody will then bond to the foreign antigen and remove it from the body.

6. **Phagocytes**

Key Term

Phagocyte (fag´-uh-sit)—A cell within the body that destroys invading organisms by engulfing and surrounding them

✔ **NOTE:** Phagocytes often seek out cells to which antibodies have attached.

OBJECTIVE 9

Define the factors that influence the virulence of a pathogen in a host's body.

1. **Ability to infect**—The capacity of an organism to cause disease despite a host's resistance

   ✔ **NOTE:** Some organisms are generally very effective in their ability to cause an infection despite the host's health and resistance. For example, if a person has not developed **immunity**, exposure to the measles virus will normally result in an 80 to 90 percent infection rate, even among healthy individuals. By contrast, the rhinovirus that causes the common cold is not very effective against persons who are healthy, rested, and well nourished.

2. **Invasiveness** (in-va´-siv-nes)—The level of success an organism experiences upon entering a host; a measure of the number of organisms that are able to enter a host's body

   ✔ **NOTE:** Invasiveness is tremendously influential in determining whether an infection occurs and how severe it is. Thus, a person who is present when an infected person sneezes across the room will be exposed to the pathogens, but the number of organisms that reach that person will be much lower than those that reach someone standing close to the infected person. If an organism gains entry through the mouth, it may not be as infectious as if it had entered through broken skin.

3. **Toxigenicity** (tawk-si-juh-nis´-uht-e)—The relative strength and the amount of toxins produced by an organism

   ✔ **NOTE:** The effects of most pathogens come from their disruption of normal cell processes. In most instances, these disruptions are caused by toxins that the pathogen produces, such as enzymes, hemolysis, coagulase, endotoxins, and exotoxins. The pathogen's toxigenicity affects its virulence, especially when considered in terms of the infected person's **susceptibility** to the toxins.

KEY TERMS

Immunity (im-yu´-nuht-e)—The state of being protected from the effects of a pathogen, generally due to having received a vaccination or because of the body's production of antibodies from a previous exposure to the organism

Susceptibility (suh-sep-tuh-bil´-uht-e)—The degree to which a person is likely to contract a disease

OBJECTIVE 10

State the functions of the body's physical barriers to infection.

1. **Perspiration**—Helps to cleanse the pores and raise the level of acidity on the skin
2. **Tears**—Rid the eyes of contaminants and help to seal and lubricate the eyelids to prevent entry of organisms
3. **Saliva**—Contains enzymes that help break down invading pathogens and prevent them from colonizing in the mouth

4. **Vaginal secretions**—Maintain a slightly acidic environment to prevent microorganisms from becoming established
5. **Mucus**—Provides a coating that prevents pathogens from making direct contact with the skin
6. **Cerumen** –Provides a coating that prevents pathogens from contacting delicate areas of the skin in the ear canal

KEY TERM

Cerumen (suh-ru´-muhn)—Ear wax, a secretion of the ceruminous glands in the ear canal

7. **Normal flora**—Compete with invading microorganisms to prevent them from becoming established

OBJECTIVE 11

State the functions of the special structures, chemicals, and actions within the body that provide protection against infection.

1. **Ciliated membranes**—Present physical barriers to contaminated particles and help to hold mucus in place
2. **Lysozymes**—Inhibit the growth of bacteria in tears and saliva
3. **Digestive fluids**—Inhibit the growth of bacteria in the stomach and intestines
4. **Normal flora**—Compete with invading pathogens
5. **Flushing actions**—Remove pathogens through the movement of liquids

   Example: Respiration
6. **Protective reflexes**—Generally expel contaminated substances from the body

KEY TERMS

Lysozyme (li´-suh-zim)—An enzyme with antiseptic actions that destroys some foreign organisms

Protective reflex (pruh-tek´-tiv re´-fleks)—Coughing, sneezing, vomiting, tearing of the eyes, or other action that provides protection against pathogens

OBJECTIVE 12

Define the term *immunology*.

- **Immunology**—The study of the ways in which the body resists infection

OBJECTIVE 13

Define the types of immunity.

1. **Genetic immunity**—Immunity based on one's inherited genetic makeup rather thar on the production of antibodies

   ✔ **NOTE:** Essentially, the term *genetic immunity* means that an organism is not susceptible to a given pathogen that may invade it. Genetic immunity may appear in a racial group, within families, or apparently at random in certain individuals. Such immunity may also be species specific—some species of organisms are immune to infection by a pathogen while other species of organisms are susceptible.

2. **Naturally acquired active immunity**—Long-term immunity acquired when a person contracts a disease and his or her body naturally produces antibodies in response to the pathogen and memory cells that protect that person from the pathogen

   ✔ **NOTE:** A naturally acquired active immunity may protect a person from a pathogen for many years or even for the rest of the person's life.

3. **Artificially acquired active immunity**—Long-term immunity acquired when a person is given a **vaccine** and his or her body produces antibodies in response to the vaccine and memory cells that protect that person from the pathogen

   ✔ **NOTE:** Booster vaccinations may be required to provide an individual with lifelong immunity from the pathogen.

4. **Naturally acquired passive immunity**—Temporary immunity acquired when antibodies are passed to a fetus through the mother's blood or to an infant through the mother's milk when the infant is breast-feeding

5. **Artificially acquired passive immunity**—Temporary immunity acquired when an **immune serum** is injected into a person's bloodstream

   ✔ **NOTE:** An immune serum does not contain memory cells, thus, the immunity provided by the serum is temporary (passive).

KEY TERMS

Vaccine (vak´-sen)—A suspension of diluted or killed microorganisms administered in order to stimulate the production of antibodies to promote an active immunity to that pathogen

✔ **NOTE:** Vaccines may be injected into the bloodstream; however, vaccines that use other portals of entry, such as ingestion, have been developed.

Immune serum (im-yun´ sir´-uhm)—A serum that is taken from another organism (animal or human) and that contains antibodies against a specific disease

OBJECTIVE 14

Define the types of cellular and tissue defense-mechanism processes the body uses against disease and infection.

✔ **NOTE:** We tend to think of diseases as affecting a person. In truth, the actual invasion that leads to diseases generally occurs at the cell level. There are several ways in which the cell and the body can fight back. First, the cell may release a chemical called *interferon* that interferes with the metabolism of the invading pathogen. The body can fight the infection by activating white blood cells that attack the pathogen individually or in combination with each other. At the tissue level, the body may exhibit an inflammatory reaction that involves physical and chemical responses that make it more difficult for an infection to spread. In this objective, you will learn general definitions for these four defense-mechanism processes. Subsequent objectives cover these defense mechanisms in more detail.

1. **Interferon** (int-uh-fir´-awn) **response**—The process by which a cell releases chemicals that interfere with a virus' ability to reproduce within a cell

   ✔ **NOTE:** In order to reproduce, viruses must be inside cells. However, the virus cannot multiply and spread if it does not reproduce. While interferon does not prevent the infection of that particular cell, it does prevent the virus from reproducing viruses that could spread to other cells. Artificial interferon is used to fight cancer because of this effect.

2. **Phagocytosis** (fag-uh-suh-to´-suhs)—The process in which a moving cell engulfs a mass of foreign material

   ✔ **NOTE:** Blood consists of three major types of cells: red blood cells, white blood cells, and platelets. These will be discussed in detail in the circulatory-system modules in Module Set II. However, white blood cells play an important role in the body's defense mechanisms and need to be covered here (see Objective 15). For example, one function of certain white blood cells is to clean up dead cells and other debris of metabolism. They perform this function by surrounding the debris through phagocytosis. White blood cells can also perform phagocytosis on invading pathogens as a defense mechanism.

3. **Serum-protein response**—The process by which components of the blood and lymph analyze captured pathogens to help develop immunity reactions to the pathogens

   ✔ **NOTE:** Serum proteins are components of blood and lymph. There are two types of serum-protein responses related to immunity. These are explained further in Objective 20.

4. **Inflammatory reaction** (inflammatory response)—The process by which tissues in an area of injury or infection work to trap pathogens in the area

   ✔ **NOTE:** The interferon response, phagocytosis, and the inflammatory reaction are all intended to provide a defense against a present, immediate pathogen threat. The serum-protein responses provide immediate defense, but they also help to improve the body's immunity as a defense against future invasions of that pathogen (resistance).

OBJECTIVE 15

Match types of white blood cells to their correct descriptions.

✔ **NOTE:** Five types of white blood cells are described below. Each type of white blood cell or leukocyte (lu´-kuh-sit) plays a role in one or more of the cell and tissue defense mechanisms. Additionally, for each type of white blood cell, there are variations that serve specific purposes in the body's response to pathogen invasion.

1. **Neutrophil** (nu´-truh-fil)—A type of white blood cell that is the first to respond to an inflammatory reaction, where it performs phagocytosis on pathogens

   ✔ **NOTE:** Neutrophils make up approximately 55 to 70 percent of the white blood cells. Neutrophils provide a quick response that is not as organized and specific as subsequent reactions. Basically, they charge into the infected site and begin attacking foreign materials.

2. **Lymphocyte** (lim´-fuh-sit)—One of two types of white blood cells—a T cell or a B cell—that performs various functions related to recognizing, marking, and remembering pathogens based on their antigens

   ✔ **NOTE:** Approximately 20 to 35 percent of the white blood cells are lymphocytes. The two major types of lymphocytes—T cells and B cells—are discussed in more detail in Objective 18.

3. **Monocyte** (mawn´-uh-sit)—A type of white blood cell that enlarges to form a macrophage (mak´-ruh-faj) in order to perform more-rapid phagocytosis

   ✔ **NOTE:** Monocytes compose 3 to 8 percent of all white blood cells. Many specialized macrophages are found throughout the body, where they often are named for the structures with which they are associated. For example, macrophages in the lungs are referred to as *alveolar macrophages*, those in the brain are called *brain microglia*, and those in the liver are *Kupffer cells*. In addition to attacking pathogens, macrophages engulf and dispose of dead and damaged tissue. This function supports the inflammatory response and aids in tissue repair.

4. **Eosinophil** (e-uh-sin´-uh-fil)—A type of white blood cell that is believed to neutralize toxins such as those secreted by some pathogens

   ✔ **NOTE:** Eosinophils make up 1 to 3 percent of the body's white blood cells. In their detoxification role, they are also important in dealing with allergic reactions.

5. **Basophil** (ba´-suh-fil)—A type of white blood cell that, as part of the inflammatory reaction, releases chemicals that allow the capillaries to be penetrated by white blood cells and other substances that accumulate at an infection site

   ✔ **NOTE:** Basophils represent less than 1 percent of the total number of white blood cells. They contain granules of **heparin** and **histamine**.

KEY TERMS

Heparin (hep´-uh-ruhn)—A chemical that helps prevent abnormal blood clotting

Histamine (his´-tuh-men)—A chemical that makes capillaries more permeable

OBJECTIVE 16

Describe the stages of the interferon response.

1. **Invasion**—The virus enters the cell.
2. **Synthesis**—The infected cell produces interferon.

✔ **NOTE:** The presence of the virus stimulates interferon production. Not all cells have the ability to produce interferon, which is simply a protein that cells synthesize. However, **fibroblasts**, which are involved in healing, and many types of leukocytes are especially efficient in interferon production.

KEY TERM

Fibroblast (fib´-ruh-blast)—A flat, elongated cell in the connective tissue

3. **Release**—The infected cell releases interferon into the bloodstream.

✔ **NOTE:** The presence of interferon in the bloodstream may be an additional defense against blood-transported pathogens and may serve as a signal for other defense mechanisms, such as the need for phagocytes.

4. **Interference**—Interferon chemically attacks the virus and prevents it from multiplying.

✔ **NOTE:** Viruses are simply unicellular organisms that normally multiply by mitosis. Interferon prevents normal cell division from occurring in the virus. If the virus cannot divide, it will not be able to multiply and spread the infection. Interferon may be largely responsible for the self-limiting nature of many infections.

5. **Phagocytosis**—The infected cell and the inhabiting virus are engulfed by a phagocyte.

✔ **NOTE:** Releasing interferon does not save the cell that has been invaded. That cell simply becomes a container for the trapped virus. The cell will die or will be perceived by phagocytes as damaged. The phagocytes will thus engulf and dispose of the cell and the virus.

OBJECTIVE 17

Describe the stages of phagocytosis.

1. **Invagination** (in-vaj-uh-na´-shuhn)—A phagocyte folds part of itself to create **pseudopods** that pull a pathogen to the body of the phagocyte.

✔ **NOTE:** Several pseudopods may form in the surface of the phagocyte. The pseudopods extend toward the material that the phagocyte is going to engulf—the pathogen—wrap around it, and pull the material toward the body of the phagocyte.

KEY TERM

Pseudopod (sud´-uh-pawd)—An extension of the surface of a phagocyte; a "false foot"

2. **Engulfment**—The pathogen is completely surrounded by the body of the phagocyte.

3. **Vacuole formation**—The phagocyte creates a vacuole around the engulfed pathogen.

✔ **NOTE:** The vacuole provides a sac in which the pathogen can be digested. The vacuole is called a *phagosome* (fa´-guh-som) and is moved toward the center of the phagocyte.

4. **Fusing**—A **lysosome** fuses with the vacuole so that the contents of the lysosome are emptied into the vacuole containing the engulfed pathogen.

KEY TERM

Lysosome (li´-suh-som)—A particle that contains digestive enzymes and hydrogen peroxide that chemically dissolve an engulfed pathogen

5. **Release**—The phagocyte releases the contents of the vacuole or dies and then eventually decomposes.

✔ **NOTE:** Phagocytes do not live very long and have essentially served their purpose when they have engulfed and digested invading pathogens or damaged cells and tissue. The accumulation of phagocytes and other debris is the main source of pus in an infection site.

OBJECTIVE 18

Distinguish between the definitions of a T cell and a B cell.

1. **T cell**—Type of lymphocyte that is formed either in the fetal thymus gland or in the bone **marrow** and passes through the thymus on its way to the lymph nodes and spleen

2. **B cell**—Type of lymphocyte that is formed in fetal bone marrow and moves directly to the lymph nodes and spleen

KEY TERM

Marrow (mar´-o)—The inner structure of most large bones

OBJECTIVE 19

Match types of T cells and B cells to their correct functions.

1. **Helper T cells**—Seek out phagocytes that have engulfed pathogens and examine the antigens of captured pathogens; may also present the foreign antigen to B cells

✔ **NOTE:** Phagocytes present the antigens of a captured pathogen to helper T cells, which become **sensitized** to the pathogen.

KEY TERM

Sensitized (sen′-suh-tizd)—Capable of being affected by a specific stimulus

2. **Sensitized helper T cells**—Divide rapidly to produce memory, cytotoxic, and suppressor T cells
3. **Memory T cells**—Carry the imprint of a particular pathogen's antigens and store the imprint in preparation for future invasions of the pathogen
4. **Cytotoxic** (sit-uh-tawk′-sik) **T cells**—Chemically rupture the cell membrane of infected cells to prevent the pathogen from reproducing and also produce chemicals called *cytokines* (si′-to-kins) that attract phagocytes to the area where the pathogen is located

   ✔ **NOTE:** Cytotoxic T cells are also referred to as *killer T cells*. The rupturing of the pathogen's cell membrane is referred to as ***lysis***.

KEY TERM

Lysis (li′-suhs)—A process of disintegration or dissolution (as of cells)

5. **Suppressor T cells**—Suppress the immune response once a foreign antigen has been destroyed
6. **Inactive B cells**—Reside in the liver, spleen, and lymph nodes until exposed to the antigen of their target pathogen
7. **Activated B cells**—Divide into memory B cells and plasma cells
8. **Memory B cells**—Remember the antigen and will become involved in responding to any subsequent invasion by that pathogen
9. **Plasma cells**—Produce antibodies specific to a pathogen's antigen and tag the pathogen cells for destruction by phagocytes

OBJECTIVE 20

Distinguish between descriptions of the types of immunity development in the serum-protein response.

✔ **NOTE:** As noted previously, immunity depends on the ability of the body's defense mechanisms to recognize invading pathogens. Such recognition may be nonspecific, such as when a phagocyte attacks any cell that it does not recognize as "self." On the other hand, immunity may be specific to a pathogen due to the body's ability to recognize the antigens of that pathogen. The body uses two processes to acquire this type of immunity as described in this objective.

1. **Cell-mediated immunity**—Relies on the ability of memory T cells to recognize a pathogen's antigen

2. **Humoral-mediated immunity**—Relies on the production of antibodies that will recognize subsequent invasions of a pathogen

✔ **NOTE:** Because of the involvement of antibodies, this process is also referred to as *antibody-mediated immunity*.

KEY TERM

Humoral (hum´-uh-ruhl)—Referring to the old concept of the body having four basic humors or fluids, including the plasma in which humoral-immunity development takes place

OBJECTIVE 21 **Describe the stages of cell-mediated immunity development in the serum-protein response.**

1. **Phagocyte location**—T cells are released in a form called *helper T cells* to seek out phagocytes that have engulfed pathogens.
2. **Sensitization**—The T cells become sensitized to the pathogen antigens in the phagocytes.
3. **Cloning**—The sensitized helper T cells form other sensitized helper cells and memory, cytotoxic, and suppressor T cells.
4. **Pathogen binding**—The cloned cells travel to the site of the infection and attach to the antigen of pathogen cells.
5. **Cytokine release**—The cytotoxic T cells secrete cytokines to disrupt pathogen metabolism and to attract phagocytes to the area.
6. **Macrophage response**—Macrophages migrate to the infection site and engulf pathogens and damaged cells.
7. **Suppression**—Suppressor T cells secrete macrophage-inhibiting chemicals once the foreign antigen has been destroyed.

OBJECTIVE 22 **Describe the stages of humoral-mediated immunity development in the serum-protein response.**

1. **Sensitization**—Helper T cells present the pathogen antigen to B cells, which become sensitized to the antigen.
2. **Cloning**—The B cells form memory B cells and plasma cells.
3. **Antibody production**—The plasma cells produce antibodies specific to the pathogen's antigen and tag the pathogen cells for destruction by phagocytes.
4. **Macrophage response**—Macrophages migrate to the infection site and engulf pathogens and damaged cells.

5. **Complement cascade**—Enzymes in the plasma cause a chain of chemical reactions that result in the complement components rupturing pathogen cells and in other actions such as attracting neutrophils to the site.

   ✔ **NOTE:** The plasma complement includes around 20 proteins that work together when activated to respond to a pathogen invasion. In some cases, the complement response can take place for nonspecific immunity without involving antibodies.

OBJECTIVE 23

Define the phases of the antibody-production cycle that follows the body's exposure to an antigen.

✔ **NOTE:** The following cycle occurs whether the initial infection occurs naturally or as a result of a vaccination.

1. **Lag phase**—The phase during which the body detects an unrecognized foreign antigen and begins to react

   ✔ **NOTE:** Generally, the body produces antibodies only after an exposure to an unrecognized foreign antigen. The body recognizes its own antigens and usually only attacks foreign antigens.

2. **Primary-response phase**—The phase during which the body produces (1) antibodies that "fit" the previously unrecognized antigen and (2) memory cells that will recognize that antigen during any subsequent exposure

   ✔ **NOTE:** The number of antibodies produced during the primary-response phase is generally not enough to prevent an infection, so the person usually becomes sick. After the invading antigens are removed from the body following an illness, the number of antibodies in the bloodstream declines, but the memory cells remain.

3. **Secondary-response phase**—The phase during which the body is exposed to a subsequent invasion by an antigen, the memory cells immediately recognize the antigen, and the body produces antibodies against it

   ✔ **NOTE:** If there is a second invasion by a foreign antigen, the body immediately recognizes the antigen and begins to produce antibodies based on the "memory" of the first infection. Consequently, in many cases, the body is able to produce enough antibodies in a short enough time to prevent the antigen from becoming established, and the person may not become sick.

OBJECTIVE 24

Describe the stages of the inflammatory reaction.

✔ **NOTE:** As you learned in Objective 14, the inflammatory reaction is a set of responses made by the body at the site of an injury or infection to trap pathogens in a localized area. Inflammation and the inflammatory reaction are also discussed in Module 4 of this module set. This objective concentrates on the infection-fighting aspects of the inflammatory reaction.

1. **Constriction**—The blood vessels constrict to allow blood to pool at the affected site.

2. **Dilation**—The blood vessels **dilate**, and white blood cells gather in the affected site to fight infection.

3. **Exudation**—The injured or infected cells secrete **exudate** that causes the area to swell.

4. **Barrier formation**—The exudate creates a fibrous network that prevents pathogens from spreading from the area.

KEY TERMS

Constrict (kuhn-strikt′)—To grow smaller or narrower

Dilate (di-lat′)—To grow larger or expand

✔ **NOTE:** The terms *dilate* and *constrict* have opposite meanings. Both terms are used often in anatomy and physiology. Blood vessels constrict and dilate, and so do the pupils of the eyes, as well as other body structures.

Exudate (ek′-shu-dat)—A substance that has oozed from a body, such as from a cell

OBJECTIVE 25

Match types of vaccines to their correct definitions.

✔ **NOTE:** Vaccines are intended to provide protection against a specific pathogen. To produce the vaccine, an organism must serve as a source of antigens so that the body will make antibodies in response to the vaccination. The source organism may be the actual pathogen or one that is closely enough related to the target pathogen that the resulting vaccine will produce an antibody response in the vaccinated organism. The pathogen or related species may be living or killed, or a portion of the pathogen, such as bacterial capsules or toxins, may be used.

1. **Nonpathogenic strain**—A vaccine that contains organisms of the same genus as the target pathogen but that are a species or subspecies that is not pathogenic

   Example: Some influenza vaccines

2. **Closely related microorganism**—A vaccine that contains nonpathogenic organisms that are chemically similar to the target pathogen

   Example: Early small-pox vaccinations that were based on the pathogen for cow pox

3. **Attenuated living pathogen**—A vaccine that contains live weakened or less-virulent forms of the target pathogen

   Examples: Live oral polio vaccine, live attenuated measles vaccine

KEY TERM

Attenuated (uh-ten′-yuh-wat-uhd)—Weakened or lessened in power or effect

4. **Killed pathogen**—A vaccine that contains nonliving or inactivated pathogens

   Examples: Vaccine for rabies, vaccine for typhoid fever

5. **Extract of pathogen**—A vaccine that contains components of the pathogen, such as bacterial capsules

   Examples: Pneumococcal polysaccharide vaccine, *Haemophilus b* conjugate vaccine

6. **Toxoid** –A vaccine that contains toxins or toxoids of the pathogen

   Examples: Vaccine for diphtheria, vaccine for tetanus

KEY TERM

Toxoid (tawk´-soid)—A toxin that has been modified so as not to be harmful

OBJECTIVE 26 **Define the term *hypersensitive response.***

- **Hypersensitive** (hi-puhr-sen´-suht-iv) **response**—An excessive response by the body's immune system to a foreign substance

✔ **NOTE:** In some individuals, the hypersensitive response is so excessive that the body may disrupt normal cell functions to attack the foreign substance, even to lowering blood pressure to a fatal level in a condition called *anaphylactic shock* (an-uh-fuh-lak´-tik shawk´). Hypersensitive responses to relatively harmless substances—pollen, peanuts, insect venom, etc.—are called *allergic reactions* (uh-luhr´-jik re-ak´-shuhns), and the precipitating stimulus is referred to as an *allergen* (al´-uhr-juhn).

OBJECTIVE 27 **Define the types of hypersensitive responses.**

1. **Immediate**—Hypersensitive response upon exposure to an allergen and due to an antigen/antibody reaction
2. **Delayed**—Hypersensitive response following exposure to an allergen and due to body cells reacting to the allergen
3. **Autoimmunity**—Hypersensitive response to one's own antigens

   ✔ **NOTE:** Autoimmune disorders can be caused by a number of conditions and can lead to a number of illnesses, such as some forms of diabetes, arthritis, and multiple sclerosis.

4. **Isoimmunity**—Hypersensitive response to antigens from one's own species

   ✔ **NOTE:** Isoimmunity is one of the principal reasons why a person's body rejects a transplanted organ or tissue and why a pregnant woman's body sometimes creates antibodies that attack the antigens of her fetus, resulting in birth defects or **congenital** diseases in the fetus.

KEY TERM

Congenital (kawn-jen´-uh-tuhl)—Present at birth as a result of conditions in the womb

OBJECTIVE 28

Match methods used to control the spread of microorganisms to their correct definitions.

1. **Antiseptic** (ant-uh-sep´-tik)—A chemical used to destroy or reduce the growth of pathogens on people
2. **Disinfectant** (dis-uhn-fek´-tuhnt)—A chemical used to destroy or reduce the growth of pathogens on objects
3. **Broad-spectrum antibiotic** (brawd´ spek´-truhm ant-i-bi-awt´-ik)—A chemical used to treat bacterial infections that may be caused by a wide variety of bacteria
4. **Narrow-spectrum antibiotic** (nar´-o spek´-truhm ant-i-bi-awt´-ik)—A chemical used to treat infections caused by a specific kind of bacterium or a few kinds of bacteria
5. **Sterilization** (ster-uh-luh-za´-shuhn)—A process that destroys pathogens on surfaces
6. **Pasteurization** (pas-chuh-ruh-za´-shuhn)—A process of heating a food to destroy pathogens in the food

   Example: Pasteurization of milk

OBJECTIVE 29

State reasons certain industries must control the growth of microorganisms.

1. **Public health**—To prevent the spread of illness
2. **Food preservation**—To keep microorganisms from destroying food and to prevent the spread of disease through infected food
3. **Production of sterile products**—To prevent contamination of the products during the production process
4. **Research**—To produce pathogens under controlled circumstances to gain better understanding of them and to develop vaccines and other control measures for them

OBJECTIVE 30

Describe the factors that determine the effectiveness of an antimicrobial procedure.

1. **Immediacy of initial treatment**—The effectiveness of an antimicrobial procedure depends on how quickly the antimicrobial procedure was performed after the possibility of a microbial invasion.
2. **Interval between treatments**—The effectiveness of an antimicrobial procedure depends on how much time has passed between the initial antimicrobial procedure and a subsequent procedure.

   ✔ **NOTE:** Timing of treatments has a tremendous impact on the effectiveness of an antimicrobial procedure. Basically, such treatments are a race against the growth rate of the pathogen. If the initial treatment is delayed, the pathogen will have multiplied and gotten a head start over the effectiveness of the procedure. Similarly, if there are delays between treatments, those pathogens that survive an initial treatment will have time to multiply before the procedure is repeated.

3. **High temperature**—The effectiveness of an antimicrobial procedure is increased if the procedure is performed under extremely high temperatures.
4. **Low temperature**—The effectiveness of an antimicrobial procedure can be increased if the procedure is performed under extremely low temperatures.

   ✔ **NOTE:** Extremely high temperatures and, in some cases, extremely low temperatures can kill microbes; however, warm temperatures can actually promote the spread of microorganisms.

5. **Concentration**—The strength of the antimicrobial substance used in an antimicrobial procedure can increase the effectiveness of the procedure.
6. **Type of microbe**—The effectiveness of an antimicrobial procedure is increased when the proper procedure is selected for the type of microbe it will be used against.
7. **Number of microbes**—The effectiveness of an antimicrobial procedure is increased if the procedure is initiated before there are a great number of microbes to be killed.
8. **Microbial defense**—The effectiveness of an antimicrobial procedure is increased if the microbe has not been overly exposed to the procedure and has developed defenses against the procedure.

OBJECTIVE 31

Match types of antimicrobial-control methods to their correct descriptions.

✔ **NOTE:** Physical methods are those techniques that kill or remove pathogens using physical barriers or energy transported by various means. There is not a chemical reaction or poisoning of the pathogen.

Physical methods

1. **Barrier**—Physical method used to prevent microbes from reaching portals of entry

   Examples: Gloves, face shield

2. **Moist heat**—Physical method used to kill microbes through the combined effect of heat and water that is at a temperature short of boiling
3. **Dry heat**—Physical method used to kill microbes through the effects of heat from a source such as an oven or an infrared light
4. **Pressurized steam**—Physical method used to kill all microbes and their spores through the effects of an autoclave
5. **Cold**—Physical method that will not generally kill microbes but is used to slow their growth
6. **Drying**—Physical method used to reduce the growth of fungi and some bacteria
7. **Radiation**—Physical method used to kill microbes on materials such as plastics that cannot be subjected to high temperatures

8. **Ultrasonic waves**—Physical method used to kill microbes on materials that can be safely exposed to microwaves
9. **Filtration**—Physical method used to control microbes in a fluid (liquid or gas) by forcing the fluid through a material with openings that allow the fluid to pass through but are too small to allow pathogens to pass through, leaving pathogens trapped in the material

Chemical methods

✔ **NOTE:** Chemical control of microbes is generally achieved by lysis, damaging the pathogen's genetic material, or interfering with its metabolism, as by inactivating enzymes within the pathogen.

1. **Antiseptic**—Chemical method used to destroy bacteria on living organisms
2. **Disinfectant**—Chemical method used to destroy bacteria on inanimate objects
3. **Sterilant**—Chemical method used to destroy all organisms on inanimate objects

OBJECTIVE 32 **List factors that contribute to the spread of nosocomial infections.**

1. **Improper hand-washing techniques**
2. **Inappropriate use of antibiotics**

   ✔ **NOTE:** Excessive use of antibiotics can cause the pathogens to become resistant to the effects of the medication. Antibiotics can also destroy resident flora, allowing other organisms to gain a competitive advantage.

3. **False sense of security**

   ✔ **NOTE:** Patients and caregivers are both likely to assume that the hospital and routine care techniques as well as the treatment being given are a means of protecting the patient from infections.

4. **Type of surgery performed on patient**

   ✔ **NOTE:** Some types of surgeries are more likely to lead to infections than others. Surgeries involving the abdomen, especially the intestines, may expose other parts of the body to resident microbes that are normally nonpathogenic. Burns and other injuries that break the surface of the skin and make it difficult to close off portals of entry are more likely to become infected.

5. **Caregiver's patient load**

   ✔ **NOTE:** When caregivers have frequent contact with a number of patients, their risk of exposure is increased.

6. **Type of care procedure performed**

   ✔ **NOTE:** Procedures that require the handling of body fluids, soiled dressings and bedding, exposure of surgical incisions, and close contact with contagious patients increase the risk of nosocomial infections.

7. **Facility staffing**

   ✔ **NOTE:** The number of staff members, the quality of their training, how conscientious they are, and other personal factors can contribute to the spread of infections in a health-care facility.

8. **Administration of an immunosuppressive agent**

   ✔ **NOTE:** Immunosuppressive (im-yu-no-suh-pres´-iv) agents are given to patients who have had organ or tissue transplants to reduce the chances that the patient's immune system will attack the foreign cells. Persons receiving these agents are more likely to contract other infections because of their reduced defense mechanisms.

OBJECTIVE 33

Match organisms that cause common nosocomial infections to the infections they cause.

1. **Staphylococcus aureus** (staf-uh-lo-kawk´-uhs or´-e-uhs)—Responsible for a number of post-operative infections commonly referred to as *staph infections*

2. **Streptococcus** (strep-tuh-kawk´-uhs) **species**—Involved in "strep" throat, scarlet fever, pneumonia, rheumatic heart disease, and other communicable conditions

3. **Esherichia coli** (esh-er-ik´-i-uh ko´-li)—Responsible for various infections referred to as ***colitis***

   ✔ **NOTE:** *E. coli* normally reside in the human intestinal tract with no ill effect; however, during surgical procedures, the microbes may be spread to other parts of the body where they can cause various infections. *E. coli* is one of the most-common sources of nosocomial infections.

KEY TERM

Colitis (ko-lit´-uhs)—An inflammatory condition of the large intestine characterized by severe diarrhea, bleeding, and ulceration of the mucosa of the intestine

4. **Pseudomonas aeruginosa** (sud-uh-mo´-nuhs uh-rug´-i-no-suh)—Presents a particular hazard for various infections to burn victims, patients with cystic fibrosis, and those patients with certain types of cancer where the skin and mucous membranes do not afford adequate protection

   ✔ **NOTE:** *Pseudomonas aeruginosa* normally inhabits soil and water and is a transient flora for the intestines.

5. **Mycobacterium** (mi-ko-bak-tir´-e-uhm) **species**—Responsible for tuberculosis and leprosy and present a particular hazard for various infections to patients with low resistance, such as those with acquired immunodeficiency syndrome (AIDS), to those receiving immunosuppressors, and to those with pulmonary conditions

   ✔ **NOTE:** Some mycobacterium species are found in the lungs with no ill effects on the host.

6. **Human immunodeficiency virus (HIV)**—Responsible for AIDS

   ✔ **NOTE:** HIV is of particular concern to health-care workers because it can be spread through body fluids.

7. **Hepatitis** (hep-uh-tit´-uhs) **B virus**—Responsible for hepatitis

   ✔ **NOTE:** Hepatitis B virus is one of three common strains, though other strains exist. Hepatitis B is a significant threat in health care because it can be spread through body fluids.

8. **Human papilloma** (hu´-muhn pap-uh-lo´-muh) **virus**—Associated with several types of cancer, including cancers of the mouth and cervix

OBJECTIVE 34

Describe types of patient isolation used in health-care facilities.

✔ **NOTE:** Over time, there have been many modifications to the recommended methods of patient isolation. The Hospital Infection Control Practices Advisory Committee (HICPAC) of the Centers for Disease Control recommends such guidelines. At the time of this writing, HICPAC recommended three types of transmission-based precautions for air-borne, droplet, and contact transmissions of infections. These special precautions are to be modified by hospitals for local use. The list below gives some common types of isolation that have been used over the years and some general guidelines. Health-care workers are responsible for knowing the specific requirements for their facilities. More information with regard to these practices is available on the National Institute of Health web site at http://www.nih.gov.

1. **Total**—Isolation that requires a patient to have no contact with anyone

   ✔ **NOTE:** Total isolation is also referred to as *strict isolation.*

2. **Protective**—Isolation that requires that a patient not be exposed to infection risks

3. **Enteric**—Isolation that requires protection with regard to a patient's intake and output of food and liquids

KEY TERM

Enteric (en-ter´-ik)—Pertaining to the intestine

✔ **NOTE:** Enteric pathogens are present in feces and other alimentary-system wastes and can be spread in that way.

4. **Wound and skin**—Isolation that requires the use of barriers to prevent contact with moist areas

   ✔ **NOTE:** Wound and skin isolation may also be called *drainage/secretion precautions.*

5. **Respiratory**—Isolation that requires the use of a mask and separation of a patient from contact with other patients

   ✔ **NOTE:** Other special requirements may be necessary for patients with tuberculosis.

6. **Blood/body fluids**—Isolation that requires the use of gloves and other barriers and proper disposal of body fluids and contaminated materials

   ✔ **NOTE:** This type of isolation is sometimes referred to as *body-substance isolation.*

OBJECTIVE 35

Complete statements that describe recommended precautions and guidelines used in surgical suites to reduce the spread of infection.

✔ **NOTE:** Each facility will have its own set of procedures for reducing the spread of infection. The following guidelines are based on the standard precautions that the Centers for Disease Control (CDC) recommend whenever there is a chance of exposure to body-fluid-borne pathogens, including the human immunodeficiency virus (HIV).

1. **Hands and other skin surfaces should be washed immediately and thoroughly if contaminated with blood or other body fluids.**

2. **Handling of body fluids and specimens should only be done while wearing goggles, masks, gloves, and impermeable clothing.**

   ✔ **NOTE:** The CDC recommends: "all health-care workers should routinely use appropriate barrier precautions to prevent skin and mucous-membrane exposure when contact with blood or other body fluids of any patient is anticipated. Gloves should be worn for touching blood and body fluids, mucous membranes, or non-intact skin of all patients, for handling items or surfaces soiled with blood or body fluids, and for performing **venipuncture** and other vascular-access procedures. Gloves should be changed after contact with each patient."

3. **Hands should be washed immediately after gloves are removed.**

4. **Used sharps should be placed in disposable containers, using no-touch passing.**

KEY TERMS

Venipuncture (ven´-uh-puhn{k}-chuhr)—A procedure that involves puncturing a vein

Sharps (sharps´)—Instruments such as scalpels, needles, tweezers, and other devices that are capable of separating flesh; also includes foreign bodies such as glass, metal fragments, splinters, knives, and other objects that may be removed from the body and then present hazards to health-care workers

No-touch passing —Passing an object so that neither the person handing nor the person taking the object touches the object near a cutting edge

5. **Used needles should not be recapped.**

✔ **NOTE:** The CDC recommends: "all health-care workers should take precautions to prevent injuries caused by needles, scalpels, and other sharp instruments or devices during procedures; when cleaning used instruments; during disposal of used needles; and when handling sharp instruments after procedures. To prevent needlestick injuries, needles should not be recapped, purposely bent or broken by hand, removed from disposable syringes, or otherwise manipulated by hand."

6. **Staples should be used instead of sutures whenever possible.**

✔ **NOTE:** Staples present lower risk of accidental pricking of medical-staff members than does the use of a needle to sew sutures.

7. **After they are used, disposable syringes and needles, scalpel blades, and other sharp items should be placed in puncture-resistant containers for disposal.**

8. **Reusable instruments and equipment should be subjected to a level of sterilization that will ensure terminal exposure for pathogens.**

9. **Health-care workers who have sores or skin conditions that exude fluids should refrain from all direct patient care and from handling patient-care equipment until the condition resolves.**

✔ **NOTE:** The CDC advises: "pregnant health-care workers are not known to be at greater risk of contracting HIV infection than health-care workers who are not pregnant; however, if a health-care worker develops HIV infection during pregnancy, the infant is at risk of infection resulting from perinatal transmission. Because of this risk, pregnant health-care workers should be especially familiar with and strictly adhere to precautions to minimize the risk of HIV transmission."

OBJECTIVE 36

Assignment Sheet 1—Practice Critical Thinking: Complete a Case Study on Immunity and Infection

Name ______________________________ Date ______________

Evaluation criteria	**Rating**
• Directions were followed	______
• Case-study presentation followed agreed-upon format	______
• Case-study presentation met agreed-upon criteria	______
Overall rating	______

Evaluator's comments ____

____

____

INTRODUCTION

The main focus of this module has been on infection and how patients and health-care givers are protected against infections by their own bodies and by following wise precautions. In recent years, a great deal has been learned about the body's immune system and the control of infections. Much of this growing knowledge has been a result of the world's need to deal with AIDS. AIDS research has led to a number of discoveries about the immune system and about specific invasions of the body, such as cancer.

This assignment sheet contains four topic areas related to immunity and infection. Your instructor will ask you to research one of those topics.

EXERCISE

ACTIVITY CHECKLIST

Put a checkmark on the blank line before each activity below as you complete it.

______ 1. Review the objectives in the Information Sheet.

______ 2. Check with your instructor to determine which of the following four case studies you will complete. Write the number of that case study on the blank on the next page.

______ 3. Check with your instructor to determine the format (written report, Power Point presentation, poster, etc.) your instructor wants you to follow in completing your case study. Describe that format on the blanks on the next page.

_____ 4. Check with your instructor to agree upon the evaluation criteria he or she will use to evaluate your case-study presentation. Describe those criteria on the blank lines below.

_____ 5. Complete your case study and return it to your instructor for evaluation.

Case-study number ________________________________

Format of case-study presentation ________________________________

____

____

____

Evaluation criteria for case-study presentation ________________________________

____

____

____

CASE STUDY 1

Acquired immunodeficiency syndrome (AIDS) is the result of a virus that invades the body. One of the earliest indications of AIDS was the occurrence of two conditions that are rarely health issues. One was a cancer known as *Kaposi's carcinoma*. Before 1980, Kaposi's carcinoma was rarely seen and then only as a slow-growing tumor in elderly men. A number of patients were also contracting a particular type of pneumonia that is caused by the protozoan *Pneumocystis carini* (*P. carini*). Humans normally have high resistance to this protozoan and rarely contract this form of pneumonia. Further, the occurrences of Kaposi's carcinoma and *P. carini* pneumonia seem to be limited to small populations, mostly young homosexual men and injection-drug users in California and New York. Based on these facts, what conclusions can you make regarding the nature of the condition, how it affects the body, and how it spreads? What would be the logical strategy for trying to boost the resistance of the affected population and trying to rid infected persons of the virus? Finally, what precautions would be logical for health-care givers who treat AIDS patients.

CASE STUDY 2

A common theory about cancer is that cancerous cells occur in our bodies quite often. According to the theory, however, these cells seldom get established as tumors because the body's immune system normally takes care of the cancerous cells. Unfortunately, there are occasional failures in the immune system that allow cancer cells to become established. At the turn of the last century, a physician named William B. Coley gave cancer patients mixtures of pathogens intended to give them fevers. Many of Coley's patients exhibited remission of their cancers—often at a higher recovery rate than other treatments. Today, some cancers are fought with cytokines such as interferon and interleukin. Much of today's cancer research involves the use of vaccines made from the patient's cancer cells. Based on this information and other facts that you may find, do you think that the immunity deficiency theory for cancer is valid? Why or why not? In keeping with your response, what do you think is the most likely avenue for finding a cure for cancer?

CASE STUDY 3

Recently, a number of pathogens, such as tuberculosis, no longer are affected by vaccines and other treatments. A number of antibiotics that were once effective against certain pathogens such as streptococcus have little impact. Based on what you learned about the factors that allow a pathogen to cause an infection, what do you think is the reason for this decreased efficiency in drugs and vaccines? How do you think the problem should be addressed?

CASE STUDY 4

During recent years, health facilities have made frequent changes in care procedures in order to deal with the increased incidence of AIDS, tuberculosis, and other conditions. Review the precautionary procedures used in your facility, a neighboring facility, or a fictional facility as provided by your instructor. Rate those procedures in how appropriate they are for the following types of patients. Be specific about what you think is proper and how some precautions should be changed.

- An HIV-positive woman delivering a baby
- A patient with chronic tuberculosis requiring surgery for internal injuries following a car accident
- A person with an unknown rash over his entire body who requires a tracheotomy because his throat has swollen shut
- An irrational patient with self-inflicted wounds that require surgical attention

MODULE SET I: Introduction to Anatomy and Physiology

Module 4: Tissues, Membranes, and Wound Healing

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Assignment Sheet

1—Practice Critical Thinking: Complete Case Studies That Consider How Tissues and Membranes Function to Maintain the Body as a Whole 41

PREREQUISITES:
Module 3

Learning Activities Sheet

Student name ________________________________

DIRECTIONS Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objectives 1 through 30.

☐ 5. **Research** Online resources to learn more about tissues, membranes, and wound healing. Your instructor will list several web sites on the blanks below. Visit at least three of the following Internet sites.

- ________________________________
- ________________________________
- ________________________________
- ________________________________
- ________________________________
- ________________________________
- ________________________________

☐ 6. **Take** Written Test provided by your instructor.

☐ 7. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, repeat steps 4 through 6.

☐ 8. **Do** Assignment Sheet 1, "Practice Critical Thinking: Complete Case Studies That Consider How Tissues and Membranes Function to Maintain the Body as a Whole."

☐ 9. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 10. If the evaluation is not satisfactory, repeat step 8.

☐ 10. **Check** With your instructor for any additional assignments to be completed.

☐ 11. **Do** Additional assignments your instructor lists below.

____

____

____

☐ 12. **Take** Module Review provided by your instructor.

☐ 13. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 14. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheet, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

Module Objective Sheet

UNIT OBJECTIVE

After completing this module, you should be able to describe types of tissues and membranes, abnormalities in organ tissues and membranes, and the body's wound-healing process. You should demonstrate these competencies by completing the assignment sheet and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

SPECIFIC OBJECTIVES

After completing this module, you should be able to

1. Define the term *tissue*.
2. Match the basic types of tissue to their correct descriptions.
3. State the functions of the basic types of tissue.
4. Complete statements that describe the characteristics of the epithelium.
5. Define the types of epithelial tissue as classified by shape.
6. Define the types of epithelial tissue as classified by tissue-layer arrangement.
7. Match the classes of epithelial tissue to their correct functions.
8. Match the types of connective tissue to their correct functions.
9. Define the basic types of nerve tissue.
10. State the functions of the basic parts of a neuron.
11. Complete statements that describe how neurons function in the nervous system.
12. State the functions of the four types of neuroglia.
13. Describe the factors that determine muscle-tissue classifications.
14. Match types of muscle contractions to their correct definitions.
15. Define the term *neuromuscular excitability*.
16. Complete statements that describe the neuromuscular-excitability response.
17. State the locations of the main types of membranes.
18. State the functions of the main types of membranes.
19. Define the term *organ*.
20. List the types of tissues and membranes found in selected organs.
21. Complete statements that describe how organ systems function.

22. Match terms that describe abnormalities in organ development to their correct definitions.
23. Define the types of injuries that can damage tissue.
24. Match the types of traumatic wounds to their correct definitions.
25. Describe the causes of the characteristics of the inflammation response.
26. Complete statements that describe the phases in the body's healing response.
27. Distinguish among statements that describe the types of treatment responses in the treatment of wounds.
28. Describe the factors that affect the wound-healing process.
29. Define factors that present possible complications to the wound-healing process.
30. Match the classifications of surgical wounds to their correct descriptions.
31. Practice critical thinking: complete case studies that consider how tissues and membranes function to maintain the body as a whole. (Assignment Sheet 1)

Information Sheet

OBJECTIVE 1

Define the term *tissue*.

- **Tissue**—A collection of cells that share a similar structure and are organized to perform a specific function

OBJECTIVE 2

Match the basic types of tissue to their correct descriptions.

1. **Epithelial** (ep-uh-the´-le-uhl) **tissue**—Tissue consisting of cells bound by connective material and varying in the number of layers and in the kinds of cells (**see Figure 1**)

   ✔ **NOTE:** Epithelial tissue forms the **epithelium**. The epithelium in different parts of the body is made of simple squamous cells, simple cuboidal cells, and stratified columnar cells. For example, the stratified squamous epithelium of the epidermis comprises five different cellular layers. Objectives 4 through 7 discuss the epithelial tissue and its functions.

KEY TERM

Epithelium (ep-uh-the´-le-uhm)—The covering of the internal organs of the body, also the lining of the vessels, body cavities, glands, and organs

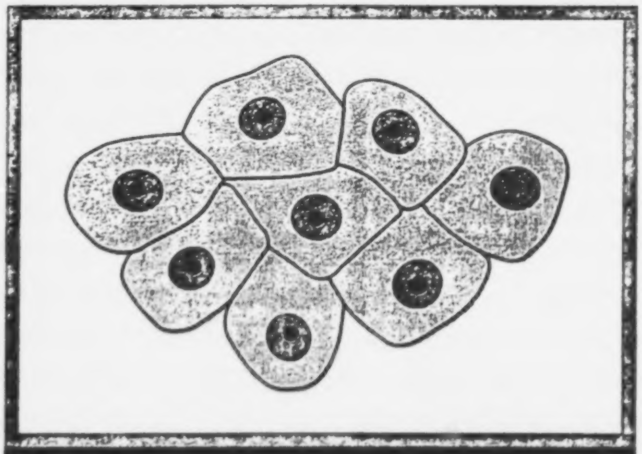

Figure 1
Epithelial tissue (surface view)

2. **Connective** (kuh-nek´-tiv) **tissue**—Dense tissue containing large numbers of cells and large amounts of intercellular material composed of fibers in a matrix or ground substance that may be liquid, gelatinous, or solid

✔ **NOTE:** The ten kinds of connective tissue are discussed in Objective 8. Fibrous tissue is one of those types and is shown in Figure 2.

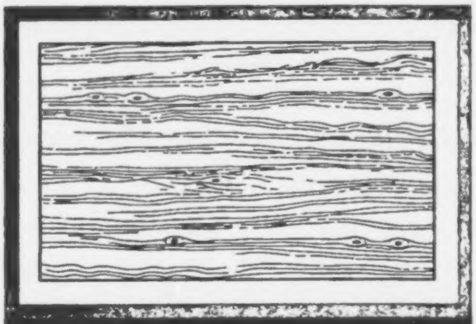

Figure 2
Connective tissue (fibrous tissue)

3. **Nerve** (nuhrv´) **tissue**—Tissue consisting of one or more bundles of impulse-carrying fibers that connect the brain and the spinal cord with other parts of the body

✔ **NOTE:** Objectives 9 through 12 discuss the types of nerve tissue and their functions. Figure 3 shows a type of nerve tissue called a *neuron.*

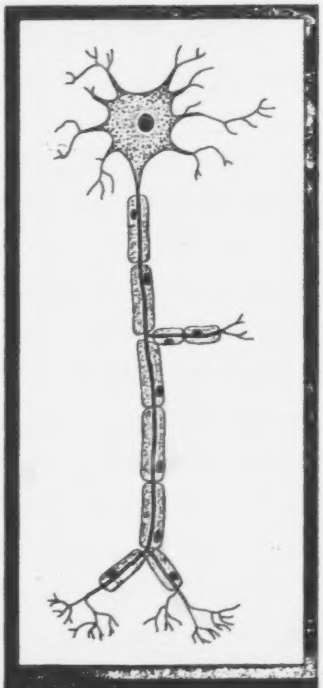

Figure 3
Nerve tissue (neuron)

4. **Muscle** (muhs´-uhl) **tissue**—Tissue composed of fibers that are able to contract, causing and allowing movement of the parts and organs of the body

✔ **NOTE:** Objective 13 discusses the classifications of muscle tissue. Figure 4 shows skeletal muscle tissue.

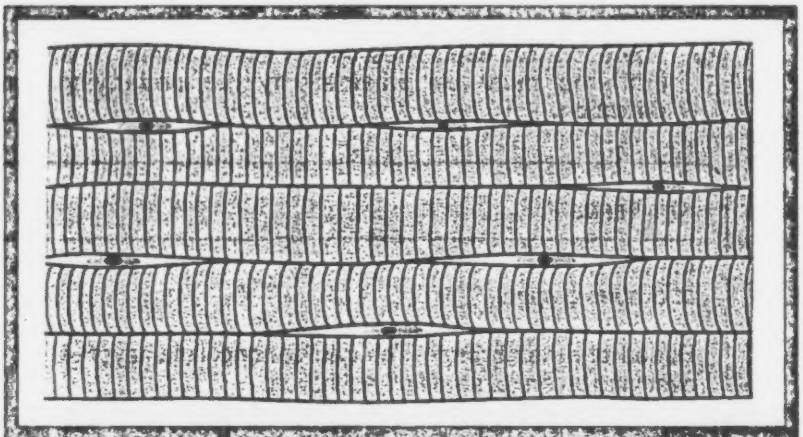

Figure 4
Muscle tissue (skeletal muscle tissue)

OBJECTIVE 3

State the functions of the basic types of tissue.

1. **Epithelial tissue**—Provides a protective barrier against extreme temperatures, environmental contaminants, and invasions by microorganisms while allowing secretion and excretion of wastes
2. **Connective tissue**—Binds to other tissue structures to support and organize the body; binds to foreign cells to protect the body; binds to molecules to transport materials through the body
3. **Nerve tissue**—Conducts electrical signals through the body
4. **Muscle tissue**—Allows the movement of the movable structures of the body

OBJECTIVE 4

Complete statements that describe the characteristics of the epithelium.

1. **The epithelium covers the body and many of its parts.**
2. **The epithelium lines the body's serous cavities; blood and lymph vessels; and the respiratory, digestive, and urinary tracts.**

KEY TERM

Serous (sir´-uhs)—Epithelial tissue that lines closed body cavities and covers the organs in that cavity

3. **The body's glands consist of epithelial tissue.**

4. **Cells that compose the epithelium are compactly arranged with little intercellular substance.**

5. **The epithelium always rests on a layer of connective tissue with a basement membrane between them.**

6. **There are no capillaries within the epithelium, which means that oxygen and nutrients must be provided by the underlying connective tissue through diffusion.**

KEY TERMS

Membrane (mem´-bran)—A thin layer of tissue that covers a surface, lines a cavity, or divides a space

Basement membrane—The fragile, noncellular layer of tissue that secures the overlying layers of stratified epithelium

Diffusion (dif-yu´-zhuhn)—The process of a substance moving from an area of high concentration to an area of lower concentration

7. **Epithelial cells undergo constant mitosis in order to replace the outer-layer cells that are lost through wear and exposure to forces and the environment.**

OBJECTIVE 5 **Define the types of epithelial tissue as classified by shape.**

✓ **NOTE:** Epithelial tissue can be classified by the shape of its cells and by its tissue-layer arrangement—whether or not the tissue consists of a single layer of cells or multiple layers. In this objective and the next, you will study the three classifications by shape and the two classifications by tissue-layer arrangement.

1. **Squamous** (skwaw´-muhs) **tissue**—Tissue consisting of flat cells that somewhat resemble scales (see Figure 5 below and Figure 8 on page 12)

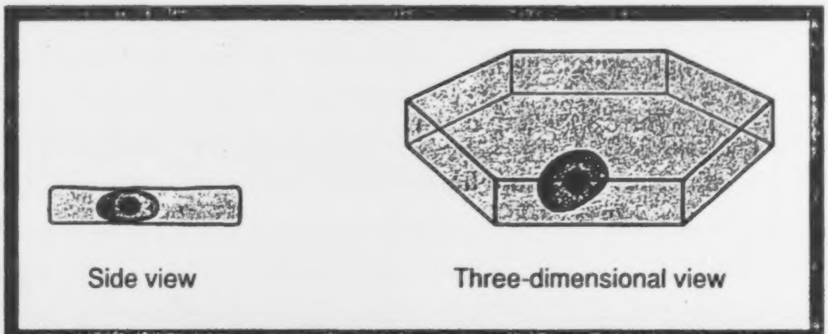

Figure 5
Squamous cell

2. **Cuboidal** (kyu-boid´-uhl) **tissue**—Tissue consisting of cells that somewhat resemble square boxes, having dimensions approximately the same height, width, and depth (see Figure 6 below and Figure 8 on page 12)

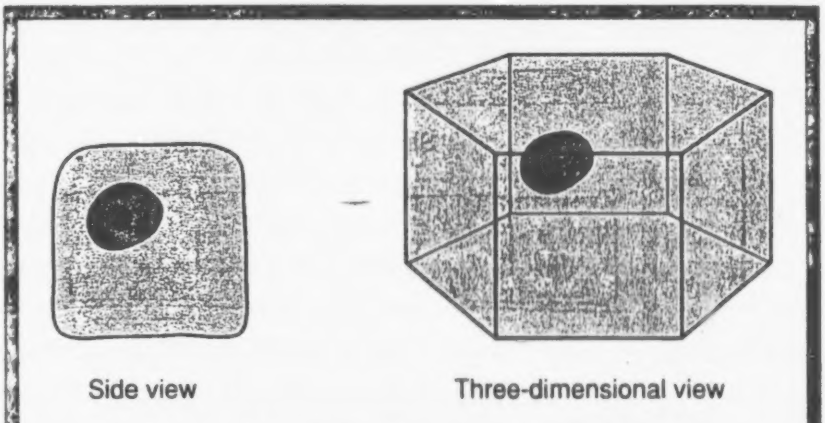
Side view
Three-dimensional view

Figure 6
Cuboidal cell

3. **Columnar** (kuh-luhm´-nuhr) **tissue**—Tissue consisting of cells that somewhat resemble rectangular boxes, having one dimension that is longer than the others (see Figure 7 below and Figure 8 on page 12)

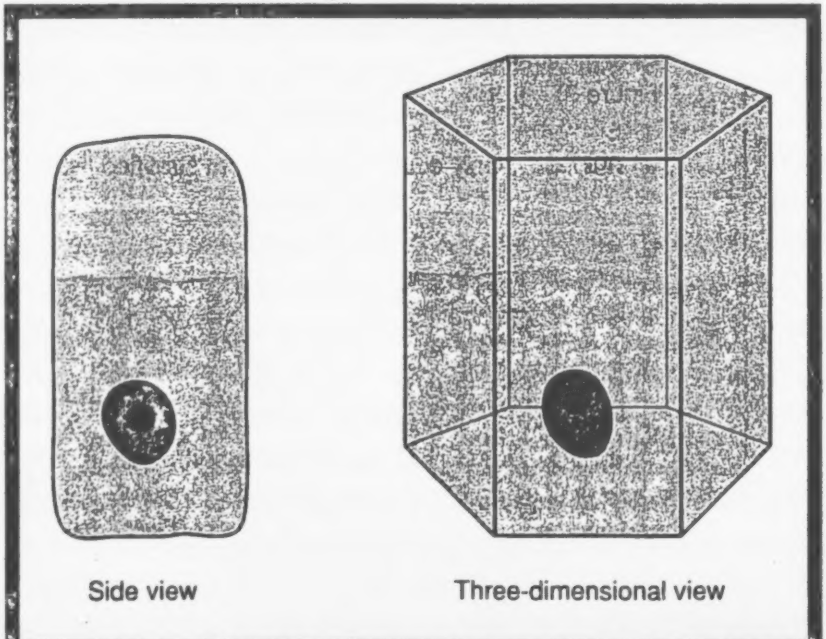
Side view
Three-dimensional view

Figure 7
Columnar cell

OBJECTIVE 6 **Define the types of epithelial tissue as classified by tissue-layer arrangement.**

1. **Simple tissue**—Tissue consisting of a single layer of cells (see Figure 8)

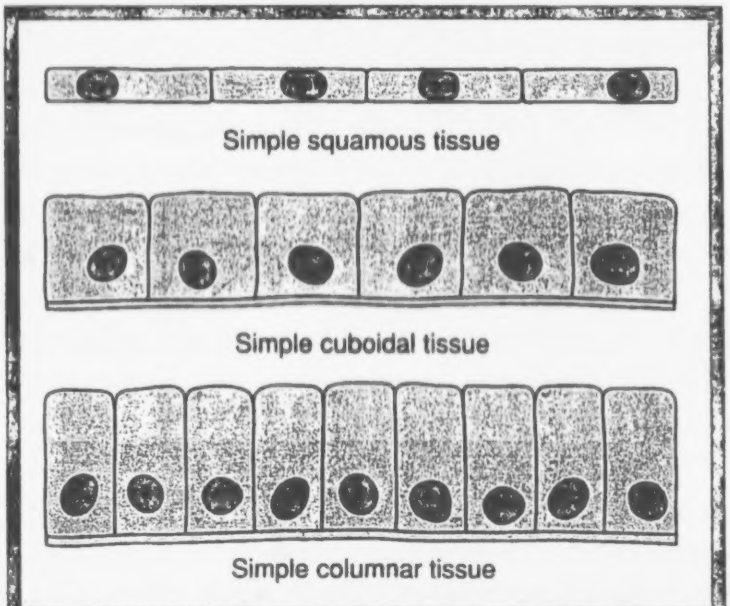
Simple squamous tissue
Simple cuboidal tissue
Simple columnar tissue

Figure 8
Simple tissue-layer arrangement

2. **Stratified** (strat´-uh-fid) **tissue**—Tissue consisting of more than one layer of cells (see Figure 9)

✔ **NOTE:** Only squamous cells form stratified tissue.

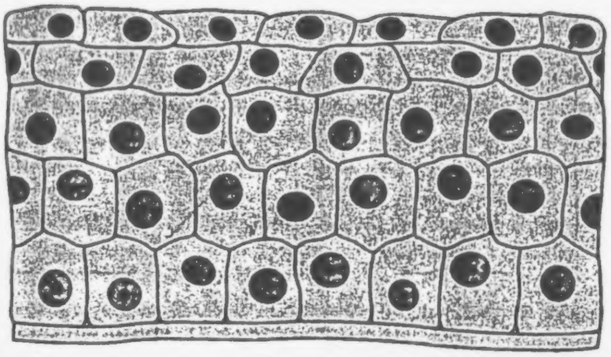

Figure 9
Stratified tissue-layer arrangement

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OBJECTIVE 7

Match the classes of epithelial tissue to their correct functions.

1. **Squamous tissue**—Lines the blood vessels and the **alveoli**; the thinness of the tissue allows gases and chemicals to pass through the tissue

KEY TERM

Alveolus (al-ve´-uh-luhs)—One of many small sacs within the lungs in which the exchange of gases take place, absorbing oxygen and releasing carbon dioxide

2. **Cuboidal tissue**—Lines glands such as the thyroid and salivary glands; the shape of the tissue promotes secretion of chemicals by the glands
3. **Columnar tissue**—Lines the stomach and intestines and secretes gastric juices and enzymes; some have cilia to sweep substances along, such as those that line the fallopian tubes and move an ovum toward the uterus
4. **Simple tissue**—Forms the single-layer linings of the capillaries, the thyroid gland, and the stomach; the thinness of the tissue allows gases and other substances to go in and out through the tissue

   Example: Oxygen flows through the capillary walls to the cells, while carbon dioxide flows from the cells into the capillaries

   ✔ **NOTE:** Simple tissue in the capillaries consists of squamous cells; simple tissue in the thyroid consists of cuboidal cells; and simple tissue in the stomach consists of columnar cells.

5. **Stratified tissue**—Forms the outer layer of the skin and the lining of the esophagus and the vagina; the thickness of the tissue and its secretions help to protect the body against pathogens

OBJECTIVE 8

Match the types of connective tissue to their correct functions.

✔ **NOTE:** Connective tissue is the most-common tissue in the body. It protects and supports organs, transports substances, and binds body structures together. Different types of connective tissue have specific locations in the body and perform specific functions.

1. **Reticular** (ri-tik´-yuh-luhr) **tissue**—Located in the spleen, lymph nodes, and bone marrow; filters harmful substances from the blood and lymph (see Figure 10)

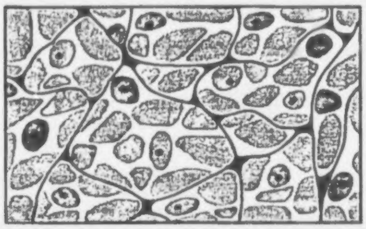

Figure 10
Reticular tissue

2. **Areolar** (uh-re´-uh-luhr) **tissue**—Located in loose accumulations between tissues and organs; connects tissues (see Figure 11)

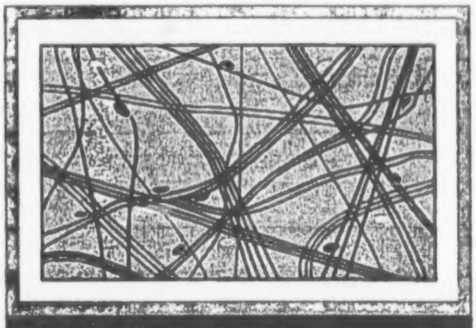

Figure 11
Areolar tissue

3. **Adipose** (ad´-uh-pos) **tissue**—Located under the skin; provides padding, insulation, and a place to store fats (see Figure 12)

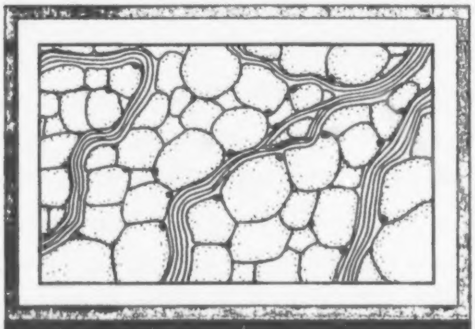

Figure 12
Adipose tissue

4. **Fibrous** (fi´-bruhs) **tissue**—Located in **tendons, ligaments, deep fascia, dermis,** and the kidneys; provides strong, flexible connections and the formation of scars (see Figure 13)

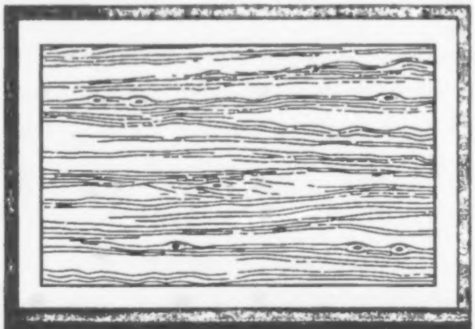

Figure 13
Fibrous tissue

KEY TERMS

Tendon (ten´-duhn)—A fibrous connective tissue that connects muscle to bones

Ligament (lig´-uh-muhnt)—A fibrous connective tissue that joins one bone to another

Deep fascia (dep´ fash´-uh)—A band of connective tissue that covers or binds together body structures within body cavities

Dermis (duhr´-muhs)—The connective tissue that makes up the inner layer of skin

5. **Bone** (bon´) **tissue**—Located in the skeleton; forms bones to support the body and protect organs and tissues (see Figure 14)

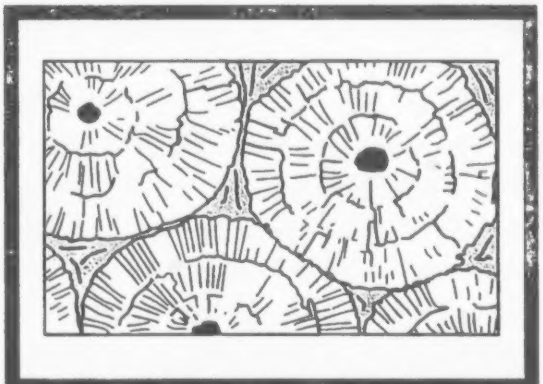

Figure 14
Bone tissue

6. **Cartilage** (kart´-uhl-ij) **tissue**—Located in the nose, ears, **trachea**, and **eustachian tubes** and at bone joints; provides a firm-but-not-rigid structure and padding between bones (see Figure 15)

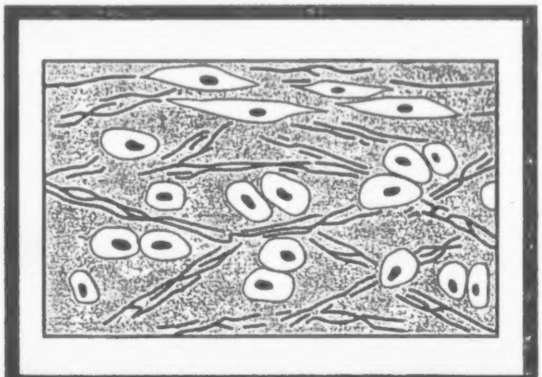

Figure 15
Cartilage tissue

KEY TERMS

Trachea (tra´-ke-uh)—The windpipe

Eustachian tube (yu-sta´-she-uhn tub´)—A canal that allows air to pass between the middle-ear cavity and the nasopharyngeal cavity

7. **Blood** (bluhd´) **tissue**—Located throughout the blood system; transports materials, including oxygen, throughout the body and combats foreign organisms and cells (see Figure 16)

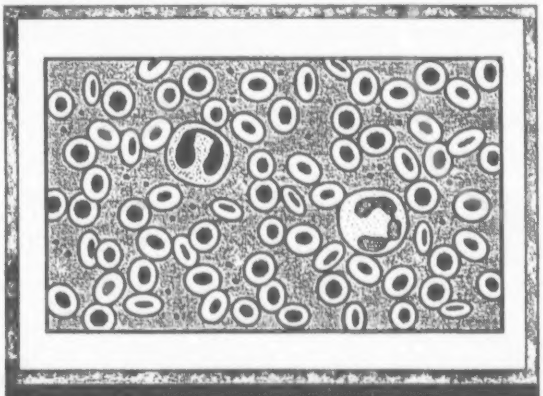

Figure 16
Blood tissue

8. **Lymphatic** (lim-fat´-ik) **tissue**—Located in the lymph nodes, spleen, tonsils, and thymus; forms certain types of white blood cells (see Figure 17)

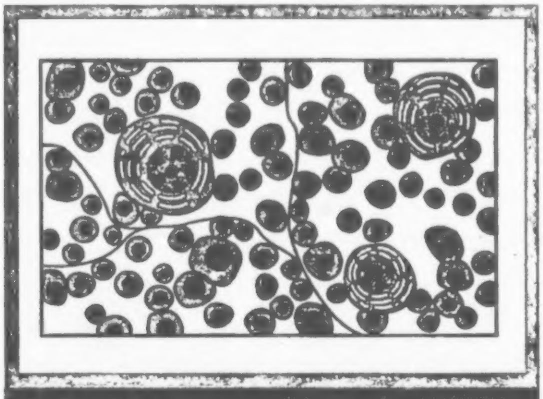

Figure 17
Lymphatic tissue

9. **Myeloid** (mi´-uh-loid) **tissue**—Located in the bone marrow; forms red and white blood cells and **platelets** (see Figure 18)

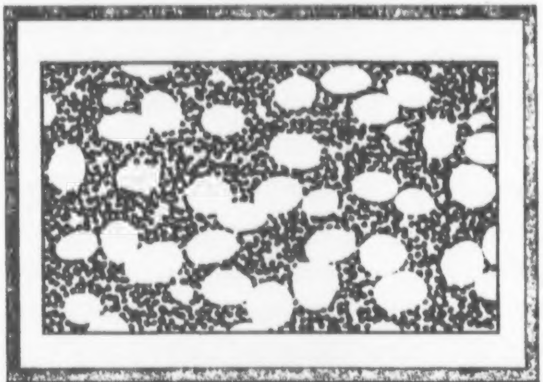

Figure 18
Myeloid tissue

KEY TERM

Platelet (plat´-luht)—A blood cell that helps the clotting process used to seal a wound

10. **Elastic** (i-las´-tik) **tissue**—Located along the walls of the large arteries and alveoli in the lungs; helps in maintaining blood pressure in the blood system and in the exhalation of breath in the lungs (see Figure 19)

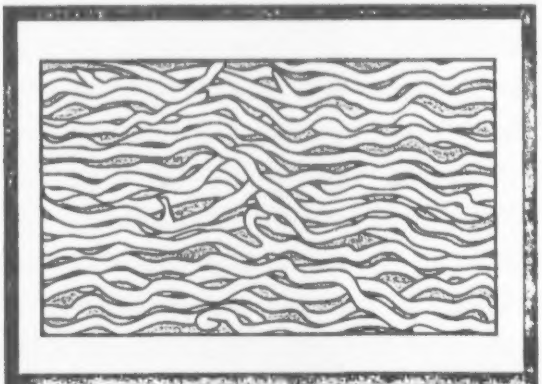

Figure 19
Elastic tissue

OBJECTIVE 9 **Define the basic types of nerve tissue.**

1. **Neurons** (nu´-rawns)—The basic nerve-tissue cells of the nervous system that are capable of generating electrochemical impulses that carry information to and from the brain (see Figure 20)

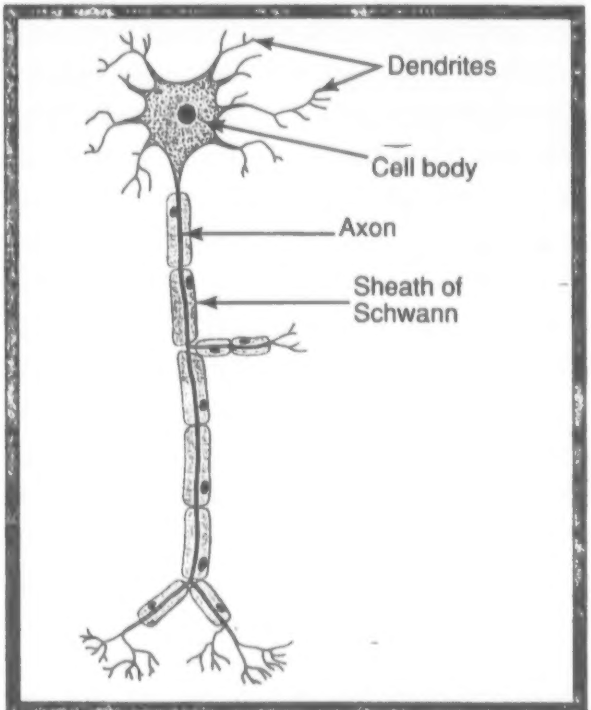

Figure 20
Basic parts of a neuron

2. **Neuroglia** (nu-ro´-gle-uh)—The supporting- or connecting-tissue cells of the central nervous system (see Figure 21)

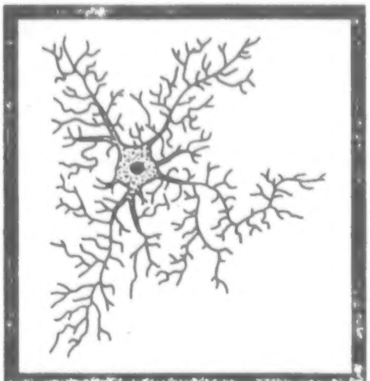

Figure 21
Neuroglia

OBJECTIVE 10

State the functions of the basic parts of a neuron.

✔ **NOTE:** Neurons consist of a cell body and two extensions: axons (ak´-sawns) and dendrites (den´-drits). A neuron will have one axon but may have several dendrites (see Figure 20 on the previous page).

1. **Axon**—Carries nervous-system impulses from the cell body
2. **Dendrite**—Carries nervous-system impulses to the cell body
3. **Cell body**—Performs metabolic and reproductive functions for the cell

OBJECTIVE 11

Complete statements that describe how neurons function in the nervous system.

1. **Neurons are surrounded by specialized cells that form the *Sheath of Schwann*, which electrically isolates neurons** (see Figure 20 on the previous page).

KEY TERM

Sheath (sheth´)—A covering, especially a loose-fitting one

2. **The axon of one neuron is separated from a dendrite of an adjoining neuron by a space called a *synapse*** (sin´-aps).
3. **Nerve-system impulses cannot cross the synapse unless it is filled with special chemicals called *neurotransmitters*** (nur-o-tranz-mit´-uhrs).
4. **There are three kinds of neurons as determined by their location and function: sensory, motor, and interneurons.**
5. **Sensory neurons, which are sometimes referred to as *afferent*** (af´-uh-ruhnt) ***neurons*, carry signals from receptors in the skin, skeletal muscles, joints, and organs to the central nervous system.**
6. **Motor neurons, which are sometimes referred to as *efferent*** (ef´-uh-ruhnt) ***neurons*, carry impulses from the central nervous system to effectors** (i-fek´-tuhrs) **that cause responses in the muscles and glands.**
7. **Interneurons, which are located in the central nervous system, carry either sensory or motor impulses or connect motor and sensory neurons and support higher-order functions such as thinking and learning.**

OBJECTIVE 12

State the functions of the types of neuroglia.

1. **Oligodendrocytes** (awl-i-go-den´-druh-sits)—Form the insulating sheath on neurons in the central nervous system
2. **Microglia** (mi-krawg´-li-uh)—Move so that they can locate and destroy damaged tissue and invading cells and organisms

3. **Astrocytes** (as´-truh-sits)—Prevent harmful chemicals from entering the brain from contaminated blood

4. **Ependyma** (ep-en´-di-muh)—Line the cavities in the brain and help to circulate cerebrospinal fluid

KEY TERM

Cerebrospinal fluid (suh-re-bro-spin´-uhl flu´-uhd)—The tissue fluid that circulates around the brain and spinal cord

OBJECTIVE 13 **Describe the factors that determine muscle-tissue classifications.**

1. **Structural composition**—Whether the muscle tissue is **striated** or smooth (nonstriated) (see Figures 22 through 24 on the next page)

KEY TERM

Striated (stri´-at-uhd)—Lined with grooves

2. **Level of conscious control**—Whether the muscle is **voluntary** or **involuntary**

KEY TERMS

Voluntary (vawl´-uhn-ter-e)—Muscles that are consciously controlled by the will of a person

Example: Muscles that move an arm

Involuntary—Muscles that work automatically

Example: Heart muscles

3. **Location**—Whether the muscle tissue is **skeletal**, **visceral**, or **cardiac** (see Figures 22 through 24 on the next page)

KEY TERMS

Skeletal (skel´-uht-uhl)—Striated, voluntary muscle tissue attached to bones

Visceral (vis´-uh-ruhl)—Smooth, involuntary muscle tissue that lines the walls of hollow organs

Cardiac (kard´-e-ak)—Striated, involuntary muscle tissue that composes the walls of the heart

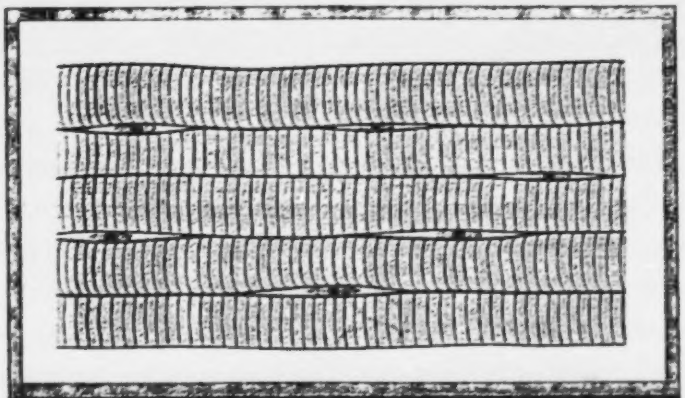

Figure 22
Skeletal muscle tissue (striated tissue)

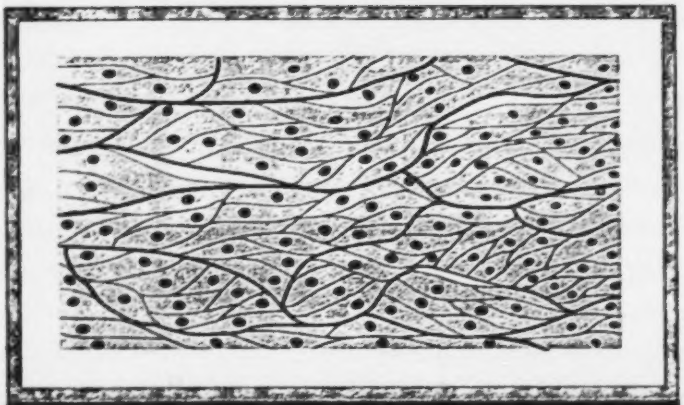

Figure 23
Visceral muscle tissue (smooth tissue)

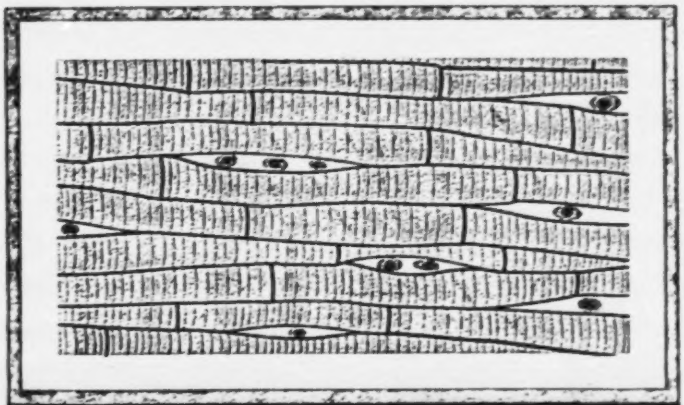

Figure 24
Cardiac muscle tissue (striated tissue)

OBJECTIVE 14

Match types of muscle contractions to their correct definitions.

✔ **NOTE:** Muscles create movement by contracting and relaxing. The most-popular explanation for how muscles contract is referred to as the *sliding-filament theory*. This theory is covered in Objective 15 and Objective 16.

1. **Flexion** (flek´-shuhn)—A movement that decreases the angle of a joint

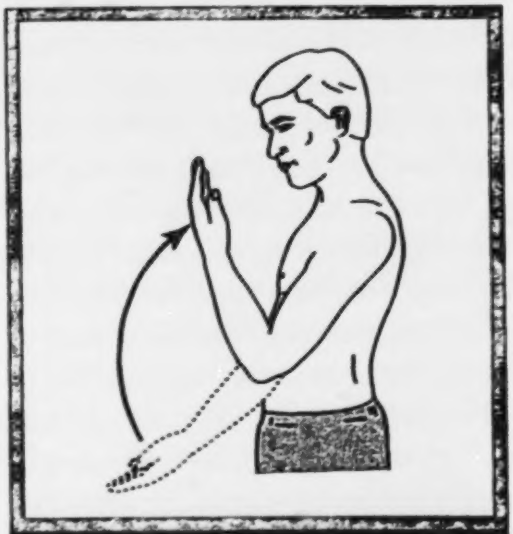

Figure 25
Flexion of the elbow

2. **Extension** (ik-sten´-chuhn)—A movement that increases the angle of a joint

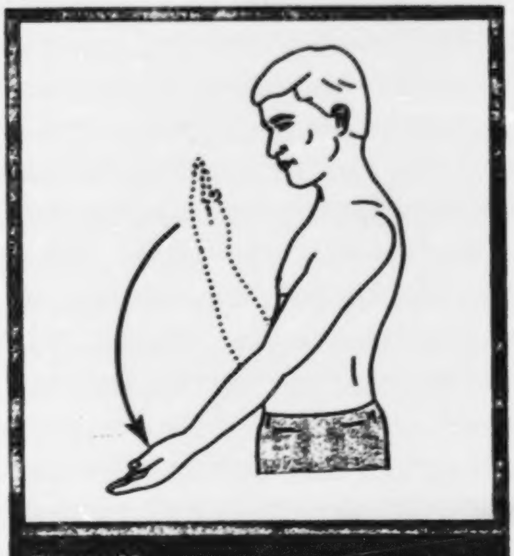

Figure 26
Extension of the elbow

3. **Adduction** (uh-duhk´-shuhn)—A movment of a limb toward the midline of the body

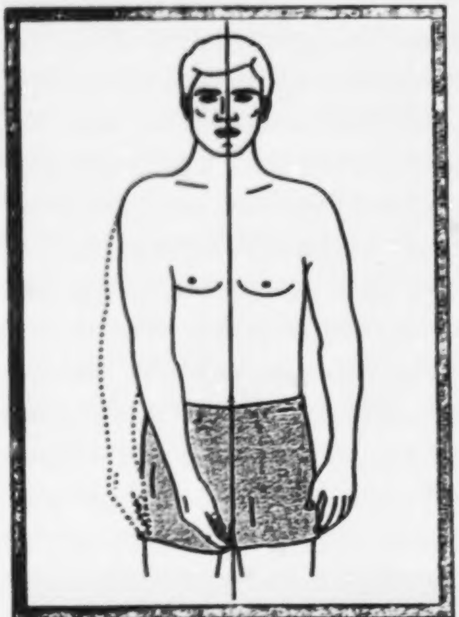

Figure 27
Adduction of the arm

4. **Abduction** (ab-duhk´-shuhn)—A movement of a limb away from the midline of the body

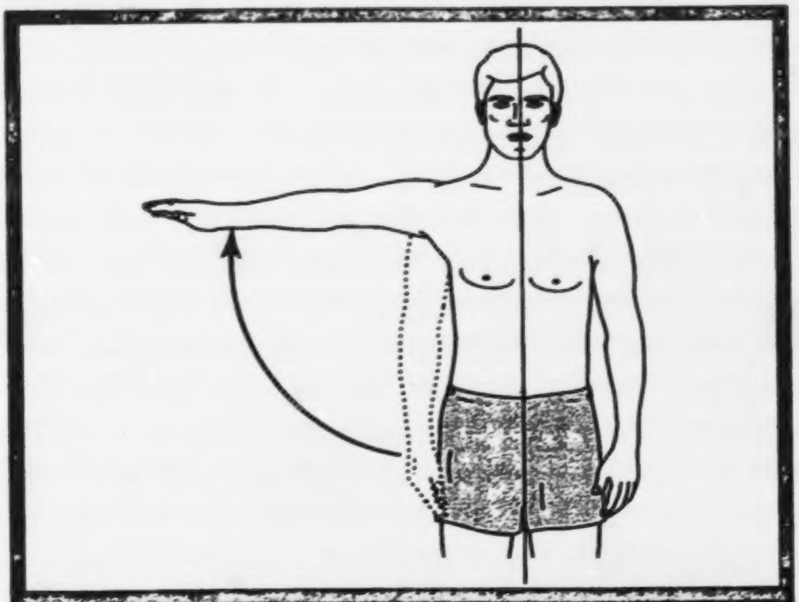

Figure 28
Abduction of the arm

5. **Pronation** (pro-na´-shuhn)—A rotating movement of the hand so that the palm faces backwards or downward; an inward and downward rotating motion of the foot

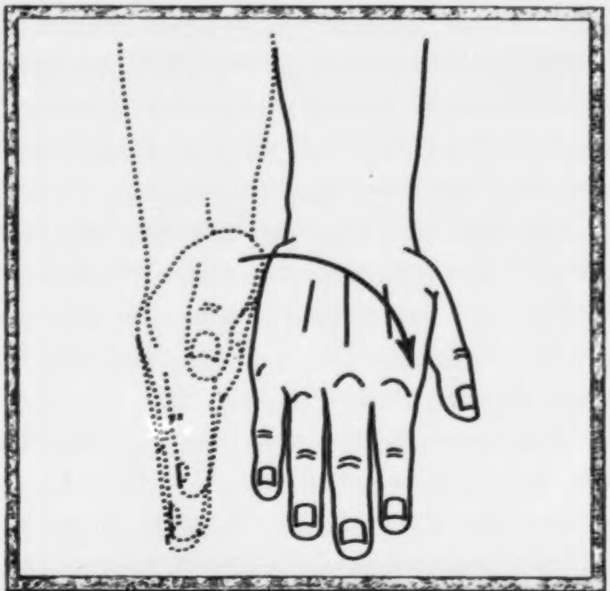

Figure 29
Pronation of the hand

6. **Supination** (su-puh-na´-shuhn)—A rotating movement of the forearm and hand so that the palm faces forward or upward; a corresponding movement of the foot and leg

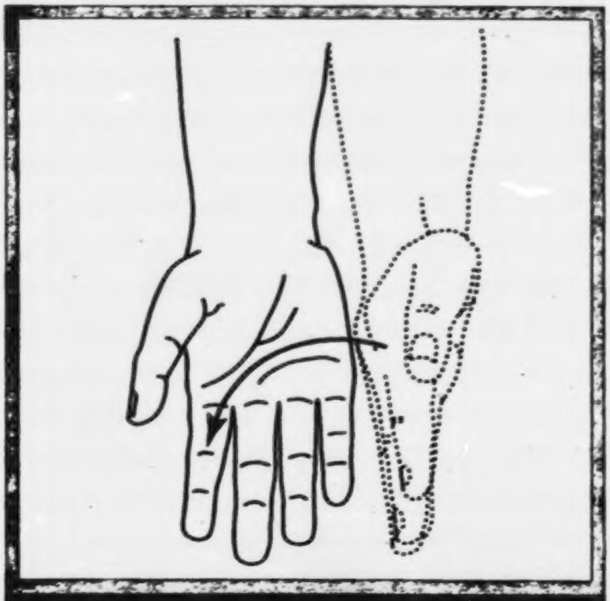

Figure 30
Supination of the hand

7. **Dorsiflexion** (dor´-si-flek-shuhn)—A movement of a part of the body toward the back

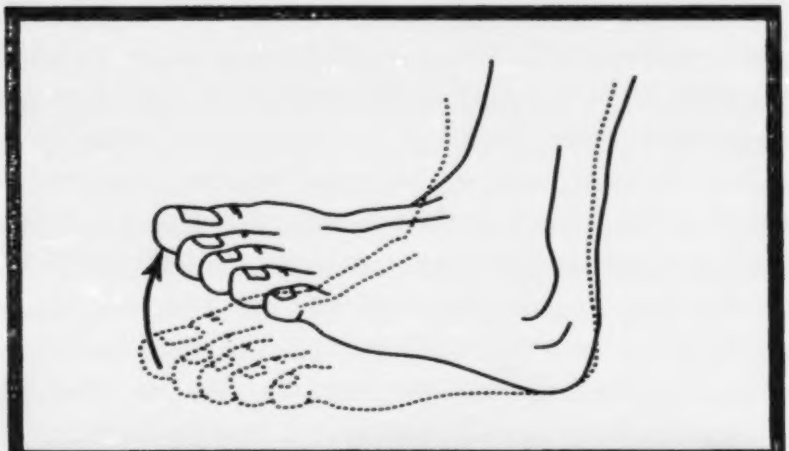

Figure 31
Dorsiflexion of the foot

8. **Plantar flexion** (plant´-uhr flek´-shuhn)—A toe-down movement of the foot at the ankle

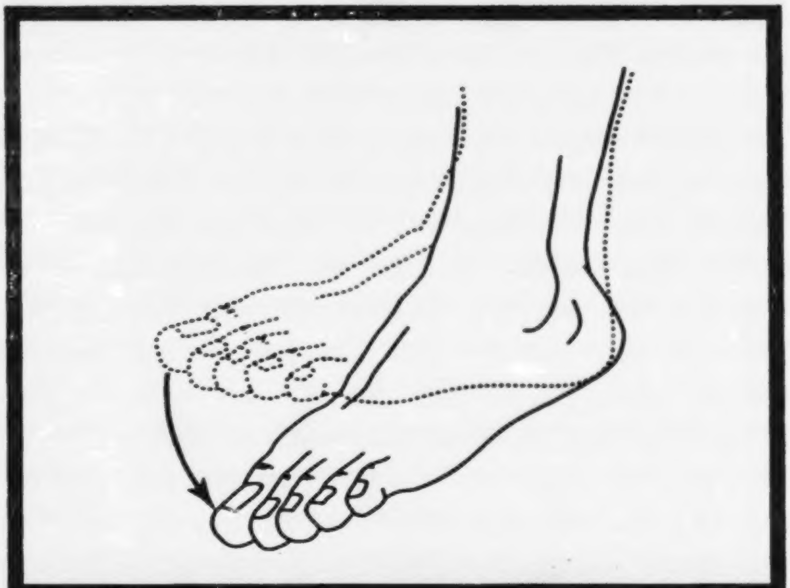

Figure 32
Plantar flexion

9. **Rotation** (ro-ta´-shuhn)—A rotating movement on an axis

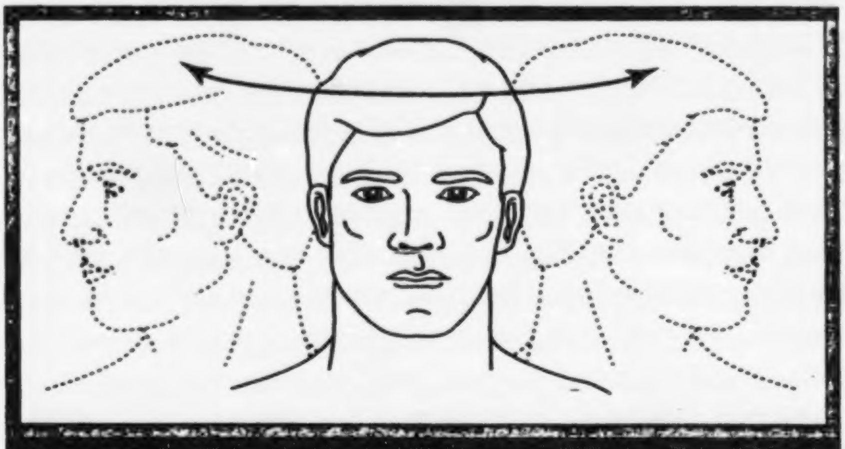

Figure 33
Rotation of the head

OBJECTIVE 15 **Define the term *neuromuscular excitability.***

- **Neuromuscular excitability** (nur-o-muhs´-kyuh-luhr ik-sit-uh-bil´-uht-e)—The response of muscle tissue to stimulation by the nervous system

  ✔ **NOTE:** Basically, the process of neuromuscular excitability involves sending an electrical impulse to selected muscle tissue to cause the muscle to contract so that a desired movement can be accomplished.

OBJECTIVE 16 **Complete statements that describe the neuromuscular-excitabililty response (sliding-filament theory).**

1. **Each muscle fiber is connected to the motor axon of a motor nerve.**
2. **The point where the neuron terminates on a muscle fiber is referred to as the *neuromuscular junction.***
3. **Sacs in the end of the nerve contain a neurotransmitter called *acetylcholine*** (uh-set-uhl-ko´-len) **(ACh).**
4. **The sarcolemma** (sar-kuh-lem´-uh) **membrane of the muscle fiber has receptors that are sensitive to ACh.**
5. **During a normally relaxed state, the outer membrane of a muscle fiber is positively charged due to an abundance of positive sodium ions (Na^+) and the core of the fiber is negatively charged due to an abundance of negative potassium ions (K^-).**
6. **A nerve impulse arriving at the motor axon causes a release of ACh.**

7. **ACh binds to the receptors in the fiber membrane, causing it to become permeable to sodium and allowing the sodium ions to move toward the core of the fiber.**

8. **An arrangement of filaments with the muscle fiber—called a *sarcomere*** (sar´-kuh-mir)**—shorten to contract the fiber.**

KEY TERMS

Permeable (puhr´-me-uh-buhl)—Capable of allowing substances to penetrate a structure

✔ **NOTE:** Permeability is often a characteristic of tissues and membranes within the body. Most are selectivity permeable—that is, they allow some substances to pass through and keep other substances from permeating, thus serving as a filter. In the case described, the fiber membrane normally keeps sodium ions from passing through until ACh binds to the receptors. Then the intercellular spaces relax and the sodium ions are able to move into the fibers.

Filament (fil´-uh-muhnt)—A threadlike, flexible structure

9. **Because virtually all of the fibers in the muscle are undergoing the same neuromuscular excitation, the entire muscle contracts.**

10. **As long as the impulses continue, the muscle will remain contracted in a condition known as *tetanus*** (tet´-nuhs).

11. **When the nerve impulses cease, the sarcolemma releases cholinesterase** (ko-luh-nes´-tuh-ras), **which inactivates the ACh.**

12. **The sodium ions flow back to the surface of the fiber so that it returns to its normal charge state of a positively charged membrane and a negatively charged core.**

OBJECTIVE 17 **State the locations of the main types of membranes.**

✔ **NOTE:** As you learned in Objective 4, a membrane is a thin layer of tissue that covers a surface, lines a cavity, or divides a space. A membrane is composed of epithelial or connective tissue. The four main types of membranes are discussed below.

1. **Mucous** (myu´-kuhs) **membrane**—Lines cavities and passages that open to the exterior

   ✔ **NOTE:** The nasal passages, for example, are lined with mucous membrane. The mucus secreted by the membrane helps to trap dirt, dust, pollen, and other substances to keep them from reaching the lungs.

2. **Serous membrane**—Lines the closed cavities of the body

3. **Synovial** (suh-no´-ve-uhl) **membrane**—Lines the skeletal joints, tendons, and **bursae**

KEY TERM

Bursa (buhr´-suh)—A sac of synovial fluid that helps to reduce friction between a bone and tendon

4. **Cutaneous** (kyu-ta´-ne-uhs) **membrane**—Covers the body as skin

✔ **NOTE:** The skin consists of three main layers: the **epidermis,** the **dermis**, and the **hypodermis**.

KEY TERMS

Epidermis (ep-uh-duhr´-muhs)—The outer layer of skin made up of an outer, dead portion and a deeper, living, cellular portion

Dermis (duhr´-muhs)—The inner layer of skin consisting of papillary and reticular layers and containing blood and lymphatic vessels, nerves and nerve endings, glands, and hair follicles

Hypodermis (hi-puh-duhr´-muhs)—The layer of areolar tissue and fat that lies beneath the dermis

OBJECTIVE 18

State the functions of the main types of membranes.

1. **Mucous membrane**—Forms a selective filter that allows some substances to enter the body while keeping others out; secretes mucus to keep its cells moist, to lubricate its surfaces, and to trap foreign particles
2. **Serous membrane**—Provides the **visceral** layer that covers organs enclosed in cavities; provides the **parietal** layer that lines cavities; secretes serous fluid to serve as a lubricant and pad between visceral and parietal layers
3. **Synovial membrane**—Secretes synovial fluid to provide lubrication and moisture
4. **Cutaneous membrane**—Secretes sweat and wastes to help maintain homeostasis

KEY TERMS

Visceral (vis´-uh-ruhl)—Of or pertaining to the viscera, or internal organs in the abdominal cavity

Parietal (puh-ri´-uht-uhl)—Of or pertaining to the outer wall of a cavity or organ

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OBJECTIVE 19

Define the term *organ*.

- **Organ**—A structure consisting of two or more tissues that performs a specific function for the body

OBJECTIVE 20

List the types of tissues and membranes found in selected organs.

1. **Heart**—Simple squamous epithelial tissue, fibrous connective tissue, cardiac muscle tissue, serous membrane

   ✔ **NOTE:** Simple squamous epithelial tissue forms the **endocardium**; fibrous connective tissue forms the fibrous **pericardium**; cardiac muscle tissue forms the **myocardium**; serous membrane forms the serous pericardium.

KEY TERMS

Endocardium (en-duh-kard´-e-uhm)—The lining of the heart chambers

Pericardium (per-uh-kard´-e-uhm)—A sac that surrounds the heart

Myocardium (mi-uh-kard´-e-uhm)—The thick middle layer of the heart wall

2. **Stomach**—Fibrous connective tissue, smooth muscle tissue, mucous membrane, serous membrane

   ✔ **NOTE:** Serous membrane forms the **peritoneum.**

KEY TERM

Peritoneum (per-uht-uhn-e´-uhm)—An extensive serous membrane that covers the entire abdominal wall of the body

3. **Nerves**—Nerve tissue
4. **Brain**—Nerve tissue
5. **Lungs**—Elastic connective tissue, epithelial tissue

OBJECTIVE 21

Complete statements that describe how organ systems function.

1. **Organs are collections of tissues that are organized in such a way that they are able to perform specific functions.**
2. **The overall goal of these functions is to maintain a state of homeostasis in the body.**

3. **Each organ system monitors one or more conditions internal to the body or in the body's external environment.**

   Examples: Internal body temperature and external environmental temperature

4. **The organs have feedback mechanisms that send signals to the central nervous system (CNS) about the conditions that they monitor.**

5. **The CNS provides response signals to organs in order to actuate regulation mechanisms designed to return the body to homeostasis.**

   ✔ **NOTE:** If the body is too hot, for example, the CNS may cause the body to sweat. Sweat carries heat from the body and air moving across the damp skin will make it feel cooler. If the body is too cold, the CNS may cause it to shiver to generate heat. If the body needs more oxygen, as during strenuous exercise, the CNS will cause faster respiration and a faster heartbeat. If a person ingests food, the CNS will direct the stomach to secrete gastric juices.

6. **Many of the response mechanisms involve physical or chemical reactions.**

7. **Organs are also involved in the transport of materials throughout the body.**

   Examples: Blood carries oxygen and digested nutrients through the body, the digestive tract moves food so that it can be absorbed, the lymph system carries lymphocytes and monocytes to the bloodstream

OBJECTIVE 22 **Match terms describing abnormalities in organ development to their correct definitions.**

✔ **NOTE:** Most developmental abnormalities in organs result from genetic defects or hormonal dysfunctions.

1. **Aplasia** (uh-pla´-zhuh)—A developmental failure resulting in the absence of an organ or tissue

2. **Hypoplasia** (hi-po-pla´-zhuh)—An incomplete development or underdevelopment of an organ or tissue, which is usually the result of a decrease in the number of cells

3. **Atrophy** (a´-truh-fe)—A wasting or diminution of size or activity of a part of the body, usually the result of an abnormal decrease in cell size

4. **Hypertrophy** (hi-puhr´-truh-fe)—An increase in the size of an organ caused by an increase in the size of the cells rather than the number of cells

5. **Hyperplasia** (hi-puhr-pla´-zhuh)—An increase in the number of cells of a body part

6. **Dysplasia** (dis-pla´-zhuh)—Any abnormal development of tissues or organs

7. **Anaplasia** (an-uh-pla´-zhuh)—A change in the structure or orientation of cells characterized by the production of abnormal, undifferentiated cells

   ✔ **NOTE:** Anaplasia is characteristic of a malignancy.

OBJECTIVE 23 **Define the types of injuries that can damage tissue.**

1. **Surgical Incision**—The separation of intact tissue by a surgeon using **aseptic** techniques
2. **Traumatic wound**—An injury to living body tissue caused by an **extrinsic** agent

   Examples: Cuts, abrasions, punctures, crushing

KEY TERMS

Incision (in-sizh´-uhn)—A smooth-sided wound, especially one made during surgery

Aseptic (a-sep´-tik)—Free from pathogens

Trauma (trau´-muh)—An injury to living tissue caused by an extrinsic agent

Extrinsic (ek-strin´-zik)—Outside of and not part of (the body)

3. **Chemical reaction**—An injury to body tissue that is the result of a response of the body to exposure to a chemical

   ✔ **NOTE:** There are a number of reactions to chemicals, both internally and externally. External exposure may lead to chemical burns, rashes, interruptions in chemical processes, and other problems. Internally, chemicals can lead to immediate death from toxin or interference with cell functioning, as with the consumption of alcohol. External chemicals can be absorbed through the skin, eyes, mucous membranes, and other portals of entry to cause internal reactions.

4. **Frostbite**—Local damage to tissue as a result of exposure to low temperatures
5. **Bacterial infection**—The death of cells as a result of the action of microorganisms
6. **Burn**—Damage to tissue due to exposure to a high-energy source

   Examples: Thermal burns, radiation burns, friction burns

OBJECTIVE 24 **Match the types of traumatic wounds to their correct definitions.**

1. **Abrasion** (uh-bra´-zhuhn)—A wound caused by friction between the tissue and a mechanical force

   ✔ **NOTE:** *Scrape* is a common term for abrasion.

2. **Contusion** (kuhn-tu´-zhuhn)—A wound caused by a force that does not break the skin but is sufficient to cause damage to **subdermal** tissues

   ✔ **NOTE:** *Bruise* is a common term for contusion.

KEY TERM

Subdermal (suhb-duhr´-muhl)—Below the skin

3. **Avulsion** (uh-vuhl´-shuhn)—A wound in which skin and underlying tissue are partially or completely torn away
4. **Incised** (in-sizd´) **wound**—A wound with smooth edges caused by a sharp surface
5. **Lacerated** (las´-uh-rat-uhd) **wound**—A wound with irregular edges
6. **Puncture** (puhn(k)´-chuhr) **wound**—A wound with little surface area that has been made by a sharp, slender object

   Example: The wound created at a needle injection site

7. **Perforated** (puhr´-fuh-rat-uhd) **wound**—A wound caused by an object passing completely through the body or a portion of the body

   Example: The wound created when a bullet enters and exits a portion of the body

8. **Crush wound**—A wound that is caused by pressure that is sufficient to alter or destroy tissue structure

   ✔ **NOTE:** A crush wound may cause the skin to rupture, break bones, burst blood vessels, and rupture or severely displace cells.

OBJECTIVE 25

Describe the causes of the characteristics of the inflammation response.

✔ **NOTE:** In Module 3, you studied the body's defenses against infection and learned that inflammation is one of those defense mechanisms. This objective provides more details of how that process works.

1. **Rubor**—Immediately upon the occurrence of an insult to a site, the blood vessels in that area constrict and then dilate, allowing blood to pool in the area as the vessels fill and blood is unable to flow quickly through the undilated vessels beyond the injured area.
2. **Heat**—White blood cells begin to accumulate in the injury site, attaching to the blood-vessel walls and leading the body to release stored white blood cells. The white blood cells begin to pass through the walls of the blood vessels to fill the interstitial spaces, attracted by chemicals such as **kinins** released by the injured tissues. The purpose of the white blood cells is to attack pathogens that may have entered the wound. They also fill the area with concentrated warmth.

KEY TERMS

Rubor (ru´-bor)—The medical term for redness

Kinin (ki´-nuhn)—A polypeptide hormone that forms in the tissues and has its chief effect on smooth muscle

3. **Swelling**—As white blood cells, chemicals, fluids that leak from damaged blood vessels and cells, and other inflammatory exudate the interstitial areas, the injury site begins to bulge. Certain proteins in the interstitial solution transform into **fibrin** to form clots that seal the area. This helps to isolate the site so that pathogens are contained and infection is more easily prevented. This accumulation of body fluid is referred to as *edema* (i-de´-muh).

KEY TERM

Fibrin (fi´-bruhn)—A stringy, insoluble protein produced in the clotting process

4. **Pain**—The inflammatory exudate, especially the chemicals released by the injured cells, result in pain. The pain may help to protect the site by telling the organism to give it attention and to be careful with it.

OBJECTIVE 26

Complete statements that describe the phases in the body's healing response.

1. **Lag phase** (substrate phase)
   - Exudate containing blood, lymph, and **fibrinogen** begins clotting and loosely binds the cut edges together.
   - Fibrin, clotting blood, and serum protein dry out, forming a scab to seal the wound.
   - **Leukocytes** remove bacteria and damaged tissue debris.

KEY TERMS

Fibrinogen (fi-brin´-uh-juhn)—A protein produced by the liver that is converted into fibrin by thrombin to promote clotting at an injury site

Leukocyte (lu´-kuh-sit)—Another term for a white blood cell

2. **Healing phase** (proliferative phase)
   - **Fibroblasts** multiply rapidly to bridge the wound gap, secreting fiber-forming **collagen**.
   - **Tensile strength** grows rapidly as the collagen network of fibers builds.
   - New cells form to replace cells that were damaged by the injury.

KEY TERMS

Fibroblast (fib´-ruh-blast)—A connective tissue cell that produces collagen and elastin fibers

Collagen (kawl´-uh-juhn)—A protein that composes strong fibers in several types of connective tissue

Tensile strength (ten´-sil stren(k)th)—A material's resistance to being torn apart by opposing forces

3. **Maturation phase** (remodeling phase)

- **Scar** tissue forms.
- The collagen reforms into cross-links that further increase tensile strength.
- As collagen density increases, the vascular makeup of the site decreases, reducing blood flow in the area so that the color of the site becomes closer to normal.

KEY TERM

Scar (skar´)—A mark left on the skin as a result of an injury

OBJECTIVE 27

Distinguish among statements that describe the types of treatment responses in the treatment of wounds.

✔ **NOTE:** The process of healing is largely dependent on how a wound is treated and how quickly. Wound treatment is performed with the intention of preventing infection and promoting healing. Ideally, after treatment the sides of a wound are properly **approximated**, the site has not become deformed by swelling, and treatment has occurred before **granulation tissue** has developed. Careful closure of the wound after trauma is then called *first-intention treatment*; second- and third-intention treatments are less-responsive treatments of wounds.

KEY TERMS

Approximate (uh-prawk´-suh-mat)—To bring two tissue surfaces close together, as in the repair of a wound

Granulation (gran-yuh-la´-shuhn) **tissue**—Any soft, pink, fleshy projections that form during the healing process in a wound not healing by first intention

✔ **NOTE:** Granulation tissue consists of many capillaries surrounded by fibrous collagen.

1. **First-intention treatment**

- The wound is closed with a **suture** soon after the incision or trauma.
- There is no **postoperative** swelling.

KEY TERMS

Suture (su´-chuhr)—A stitch placed in tissue to hold the sides of a wound together during the healing process

Postoperative (po-stawp´-uh-ruht-iv)—Following a surgical procedure

- There is no serous discharge or infection.

  ✔ **NOTE:** Wounds accompanied by infection or that are not properly healing are often accompanied by a watery discharge that oozes from the wound. The discharge consists of water and other body fluids and the by-products of the body's defense mechanisms, such as white blood cells, dead cells, fragments of pathogens, etc.

- There is minimal separation of the wound edges.
- There is minimal scar formation.
- Healing is by **primary union**.

KEY TERM

Primary (pri´-mer-e) **union**—The situation in which severed tissue is essentially reunited with the tissue from which it was originally separated and that the healing process begins without disruptions from swelling, contamination, infection, and other factors

- Healing is relatively fast.

2. **Second-intention treatment**
   - The wound is not closed with a suture.
   - There is excessive loss of tissue or poorly approximated tissue.
   - There is serous discharge and infection.
   - There is excessive separation of the wound edges.
   - There is significant scar formation.
   - Healing may produce a weak union with granulation tissue forming in the bottom of the wound and slowly contracting the wound together as it builds up.
   - Healing takes longer than normal.
3. **Third-intention treatment**
   - The wound is closed with a suture, but it is not closed immediately after the incision or trauma.
   - There may be loss of tissue due to infections or complications of the healing process.
   - There is serous discharge and infection, often after an initial suturing.
   - There is excessive separation of the wound edges due to disruption of the healing process.

- There is usually a deeper and wider scar formation.
- Healing may produce a weak union with some granulation forming in the infection site or area of poor healing.
- Healing takes longer than normal.

OBJECTIVE 28

Describe the factors that affect the wound-healing process.

1. **Age**—The body's ability to heal declines as a person ages

   ✔ **NOTE:** A number of conditions brought on by age interfere with the healing process. Tissue **vitality** decreases with age. Organs involved in the healing process may not be functioning at their full capacity. For example, an age-weakened heart and clogged arteries reduce the flow of blood to the wound site, while an elderly person's digestive system may not efficiently process the nutrients required for healing. The immune system may become less able to fend off infection with increased age.

KEY TERM

Vitality (vi-tal´-uht-e)—The ability to carry out life functions efficiently

2. **Nutritional status**—The production of cells and tissues as part of the healing process requires an adequate supply of the proper nutrients.

   ✔ **NOTE:** Zinc, protein, and carbohydrates and vitamins A, B, and C are required for proper healing. If any one of these nutrients is missing or inadequate in a patient's diet, the surgical wound will not heal as quickly.

3. **Electrolyte balance**—The transport to the wound site of nutrients, oxygen, hormones, and other substances that promote healing depends on the pathways provided by blood and interstitial fluids.

   ✔ **NOTE:** The loss of fluids and the improper balance of electrolytes interfere with the healing process by slowing down the transport of oxygen, hormones, and other substances and by disrupting cellular metabolism. The diffusion of nutrients at the cellular level is efficient only when the concentrations of solutes is balanced.

4. **Physical condition**—The good circulation and lack of fat associated with good physical conditioning reduce the chances of a wound becoming infected.

   ✔ **NOTE:** Excessive fat deposits make it difficult to get good wound closure and make the wound very vulnerable to trauma and infection. Good physical conditioning often means a good diet and adequate exercise for better overall health.

5. **Surgical technique**—Good surgical technique complements the body's healing functions while poor surgical technique interferes with the healing process.

   ✔ **NOTE:** Poor antiseptic practices can lead to infections, while improperly performed incisions or suturing can lead to a poorly closed wound, tearing of sutures, or herniation (see Objective 29). Healing is promoted when the depth and the size of the incision are kept to a minimum. The use of correct wound-closure technique can ensure that the tissue fuses well and has minimal scarring.

6. **Infection**—The fighting of an infection reduces the amount of nutrients, oxygen, and other substances that can be involved in the healing process; further, the pathogens may produce toxins that interfere with the body's chemicals that are involved in healing.

   ✔ **NOTE:** Tissues that are combating infection are slow to heal because the infection interferes with the healing process. The body's resources may be diverted away from the healing process to fight the infecting pathogens.

7. **Therapy** (ther´-uh-pe)—Treatment provided to the patient through therapy may include medications or procedures that either slow or improve the healing process.

   ✔ **NOTE:** Certain drugs, radiation, and other forms of treatment can affect the blood supply and can interfere with normal cell metabolism. On the other hand, physical therapy may include exercises that promote good circulation or a drug may reduce the chances of infection.

8. **Complications** (kawm´-pluh-ka-shuhns)—Outside influences not directly related to the surgery can interfere with wound healing.

   ✔ **NOTE:** Conditions that stress the suture, such as coughing or nausea, and infections unrelated to the primary site can slow the healing process. Some patients may have additional injuries or illnesses that divert healing resources from the surgical wound site (see Objective 29).

9. **Exercise**—The improved circulation that comes with exercise helps to deliver oxygen, nutrients, and other resources required for healing to the wound.

   ✔ **NOTE:** While exercise is helpful, it should be appropriate to the patient's condition and surgery so that the sutures are not stressed.

OBJECTIVE 29

Define factors that present possible complications to the wound-healing process.

1. **Hemorrhage** (hem´-uh-rij)—The loss of a large amount of blood in a short time caused by a failure of open blood vessels to adequately clot or to remain sealed

   ✔ **NOTE:** Clotting is an important part of the healing process because it helps to seal the wound. However, conditions such as hemophilia and anemia may prevent the blood from clotting properly. The loss of blood that results from hemorrhaging also reduces the amount of oxygen and nutrients that are available to the injured area and that are needed to promote healing.

2. **Sinus-tract formation**—The development of channels that permit the escape of **purulent** materials from pockets of pus and other fluids

   ✔ **NOTE:** Pockets of pus harbor the potential for infections to develop, and sinus tracts keep tissues separated that must be knit together during the healing process.

KEY TERM

Purulent (pyur´-uh-luhnt)—Containing pus

3. **Hematoma** (he-muh-to´-muh)—A swelling or tumor that contains blood that is generally clotted

✔ **NOTE:** A hematoma is similar to a sinus tract in that it creates a physical separation between tissues that must grow together. Hematomas also represent an area of reduced blood circulation that slows the healing process.

4. **Infection**—The presence of pathogens in a wound site

✔ **NOTE:** Infecting pathogens rob a wound site of nutrition and interfere with the normal functioning of cells. This interference may include disruption of the chemical processes involved in healing and reduction of the reproductive activities of the cells that are required to replace dead cells.

5. **Herniation**—A protrusion of an organ or tissue structure into a wound site

✔ **NOTE:** Herniation can lead to a number of complications. Like hematomas and sinus tracts, a protruding organ can force its way between tissue layers that are trying to rejoin. The pressure of the hernia can restrict blood flow, thus delaying the healing process. The hernia itself may lead to the development of other conditions, including infections, that reduce the healing resources that are available to the primary site. Depending on the organ involved, herniation may prevent the normal functioning of organs that support the healing process. For example, a herniated bowel may reduce the efficiency of digestion, a process that is vital in supplying nutrients to the body. Without proper digestion of food, proteins and vitamins that are necessary to build new cells may not enter the blood supply.

6. **Wound disruption**—One of the conditions—**dehiscence**, **evisceration**, or **eventration**—that interrupts the wound-healing process

✔ **NOTE:** Wound disruption is one of various conditions that can occur to the post-surgical patient. Generally, dehiscence, evisceration, and eventration are the result of a patient's not following postoperative-care instructions, causing the sutures to tear or the displacement of organs due to weakened tissues. Occasionally, wound disruption occurs due to poor surgical technique. Disruption usually occurs between the fourth and sixth postoperative day.

KEY TERMS

Dehiscence (di-his´-uhns)—The separation of the layers of a surgical wound

Evisceration (i-vis-uh-ra´-shuhn)—The extrusion of internal organs or viscera through a dehiscence

Eventration (e-vuhn-tra´-shuhn)—The partial protrusion of the abdominal contents through an opening in the abdominal wall

OBJECTIVE 30

Match the classifications of surgical wounds to their correct descriptions.

1. **Clean (Class I)**

   - Has an expected infection rate of 1 to 5 percent

     ✔ **NOTE:** The percentages used in this objective indicate an estimated range of infection. A rate of 1 to 5 percent, for example, means that for every 100 surgeries done under the conditions described, one to five patients will develop infections.

   - Involves an **elective procedure** done under ideal conditions

KEY TERM

Elective (i-lek´-tiv) **procedure**—An operation done by choice as opposed to being performed as an emergency

   - Exhibits primary closure with no drainage
   - Was not subjected to breaks in aseptic technique
   - Shows no inflammation
   - Did not require entry into alimentary, genitourinary, or respiratory tracts or oropharyngeal cavity

     ✔ **NOTE:** These sites are likely to contain microbes that can cause infections, including residential flora that promote health in their intended sites but may cause problems elsewhere.

2. **Clean/contaminated (Class II)**

   - Has an expected infection rate of 8 to 11 percent
   - Involves an internal procedure done under near-ideal conditions
   - Exhibits normal drainage during procedure
   - Was subjected to minor breaks in aseptic technique
   - Shows no inflammation
   - Required entry into alimentary, genitourinary, or respiratory tract or oropharyngeal cavity under controlled conditions

3. **Contaminated (Class III)**

   - Has an expected infection rate of 15 to 20 percent
   - Involves an internal procedure done under less-than-ideal conditions

- Started as an open, fresh, traumatic wound less than four hours old
- Was subjected to major breaks in aseptic technique
- Shows acute, **nonpurulent** inflammation

KEY TERM

Nonpurulent (nawn-pyur´-uh-luhnt)—Without pus

- Required entry that resulted in gross spillage or contamination from the gastrointestinal tract, entry into the biliary tract with infected bile present, entry into the genitourinary tract with urine present, or similar contamination

4. **Infected (Class IV)**

- Has an expected infection rate of 27 to 40 percent
- Involves an internal procedure done under less-than-ideal conditions
- Exhibits primary closure with no drainage
- Was subjected to microbial contamination in the operative field before the procedure
- Shows acute bacterial inflammation that may be purulent or be a known clinical infection
- Involved exposure to a **perforated organ**, such as a bowel

KEY TERM

Perforated (puhr´-fuh-rat-uhd) **organ**—An organ punctured in such a way that the contents of the organ could exude onto other structures

OBJECTIVE 31

Assignment Sheet 1—Practice Critical Thinking: Complete Case Studies That Consider How Tissues and Membranes Function to Maintain the Body as a Whole

Name ______________________________ Date ________________

Evaluation criteria	**Rating**
• Directions were followed	______
• Answers demonstrate a comprehensive understanding of the information presented in the Information Sheet	______
• Complete sentences were used in answering each case study	______
Overall rating	______

Evaluator's comments ____

____

____

INTRODUCTION

Much of this module has focused on the tissues and membranes that compose the human body. By looking at each of these components separately, you may lose sight of the fact that there is a single body and that these various components must function together to maintain the whole body. In this assignment sheet, you will be given the opportunity to consider these tissues and membranes as a unified, whole organism.

This assignment sheet contains three descriptions of the human anatomy and physiology related to tissues and membranes. Each description then asks you to draw certain conclusions about the composition of the human body. Your answers may require that you do additional research beyond the information presented in the module.

EXERCISE

ACTIVITY CHECKLIST

Put a checkmark on the blank line before each activity below as you complete it.

______ 1. Review the objectives in the Information Sheet.

______ 2. Read each case study below.

______ 3. Use the information in the Information Sheet and from outside resources to answer the questions in each case study. Use complete sentences in your answers.

______ 4. Complete the assignment and give it to your instructor for evaluation.

CASE STUDY 1

The body is composed of several types of tissues that in turn create various membranes and organs. In a healthy body, these tissues function together to maintain homeostasis. Consider each of the major types of tissue listed below and state how each contributes to homeostasis of the body.

a. Epithelial tissue ____________________

b. Connective tissue ____________________

c. Muscle tissue ____________________

d. Nerve tissue ____________________

CASE STUDY 2

Many people today are concerned about their weight, and with good reason for weight contributes to health. However, body composition varies from person to person and it is impossible to say that all persons of a certain height should ideally weigh a given amount. Variations due to gender, age, body structure, and other factors will influence what a person should weigh. All of these factors are related to the tissue composition of the body, such as the percentage of body fat. Typically, the ideal body fat is 15 to 18 percent for a man and 20 to 22 percent for a woman. Yet, a healthy person such as an athlete may have 3 to 5 percent body fat, while others may have a body-fat percentage well above the suggested ideal range. On the blanks provided below or on separate sheets of paper, discuss the advantages and disadvantages of being substantially over or under the ideal range and how these two situations may affect a surgical patient.

Case Study 3

Cancer is essentially an abnormal tissue condition involving either the production of excessive numbers of cells (hyperplasia) or the production of abnormal or undifferentiated cells that do not support the tissue function (anaplasia). Methods for treating specific cancers are typically aimed at interfering with the metabolism of the cancer cells and often the surgical removal of cancerous tissue. Chemicals (chemotherapy), vaccines and natural or artificial disease-fighting mechanisms (immunotherapy), energy (radiation therapy), and laser or conventional surgery may be used independently or in conjunction with one another to treat cancer. Your instructor will assign you a type of cancer to investigate. In the space provided below or on separate sheets of paper, (a) identify and describe the cancer, (b) list factors that contribute to the cancer's development, (c) state how the cancer affects healthy tissue, including its likelihood to spread, and (d) describe the typical treatment for the cancer and how that treatment controls or disrupts the functioning of the cancer cells/tissue.

a. Type of cancer and its description ________________________________

____

____

____

b. Factors that contribute to the cancer's development ____________________

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c. How the cancer affects healthy tissues ________________________________

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d. Typical treatment, including how that treatment affects the cancer cells/tissue ____

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